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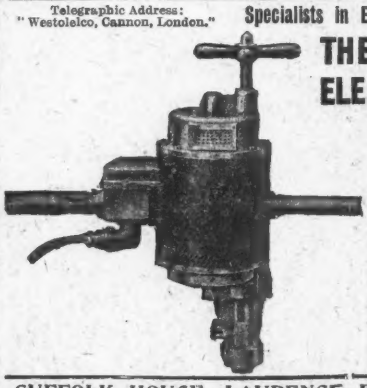

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ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE DEARNESS OF THE LOWEST TENDER.

IT is a common saying, and one that is full of sound wisdom, the fruit of long experience, that "the best is the cheapest in the end." Unfortunately, in purchasing plant, the buyer too often ignores this maxim, and appears to believe that the best is that which is cheapest in the beginning; that is to say, he accepts the lowest tender, on the faith of the assurances that he receives that the plant is "just as good" as its more costly rivals, or a bit better, and is "guaranteed" to have high efficiency, long life, and all the other virtues of high-class productions. The lowest tender is not always unworthy of consideration; when made by a firm of high standing, whose reputation is an asset that it cannot afford to depreciate, it may be, and often is, both safe and wise to accept an attractive offer. But in general the lowest tender should be most carefully scrutinised, and considered in all its bearings, before it is preferred to a somewhat higher-priced tender of unquestionable merit.

Private purchasers, of course, are able to exercise their discretion with absolutely unfettered freedom, but municipalities in this country have always before them the fear on the one hand of the Local Government Board, which is apt to give little heed to explanations justifying the payment of a higher price than the very lowest terms, and on the other of the intelligent ratepayer, who sees in any departure from the minimum price basis either an opportunity for making political capital out of the transaction, or evidence of corrupt practices which he is not slow to denounce. It is sometimes the duty of the conscientious engineer to advise his committee to brave these dangers and pass over the lowest tender, but occasions arise when even he can see no adequate reason for such a recommendation, and price must rule the choice; yet the risk remains that the bargain may turn out to be a bad one.

Such a case is recorded in the annual report of Mr. T. H. U. Aldridge, engineer-in-chief to the Municipal Council of Shanghai, which has just come to hand. Mr. Aldridge states that, in view of the price and guaranteed efficiencies of the German turbo-alternators which were installed two years ago at the Riverside generating station, the German tenders were "theoretically" the best offers received, and could not easily have been passed over. In practice, however, they proved to be most disappointing, for a crop of troubles has been experienced since they were put to work. It cannot be too widely made known in neutral and Allied markets that serious breakdowns of the German-built machines took place, and at one critical period two-thirds of the turbine plant was unavailable for service, owing to serious defects. The trouble was traced to the employment of unsuitable material for the turbine blading, but other mechanical defects were discovered later, and a serious electrical burn-out also took place, almost simultaneously with the blade troubles. The consequence has been that while the average cost of repair of six British turbo-alternators at Shanghai, aggregating 4,200 KW., which have been running for five to nine years, was under £40 each per annum, the two 2,000-KW. turbo-alternators supplied by the A.E.G., of Berlin, which have been running less than two years, have cost respectively £318 and £267 per annum, an

average of £293 each. In addition there was a serious loss of revenue whilst the A.E.G. machines were under repair. Mr. Aldridge adds: "Since those turbines were installed, troubles with machines of similar make have come to light in connection with machines in Australia and England. Not only have the German turbines proved defective in Shanghai, but several transformers have also shown marked inferiority to either British or American ones in service." Whilst we condole with Mr. Aldridge on his unfortunate experience with German generating sets, we must, in passing, once more congratulate him on the splendid progress that his undertaking has again recorded. A 52 per cent. increase in units sold, following on successive increases of 46, 80, and 50 per cent., and a load-factor of 40.8 per cent., are achievements to be proud of; the units sold now exceed 50 millions per annum, and the installation of generating plant of 25,000 KW. capacity is in hand.

Possibly one of the Australian breakdowns to which reference is made above is that of the Sydney City Council, which in 1913 bought an A.E.G. turbo-alternator for £21,233, the lowest tender by £2,077. This set was supplied through the Australian Metal Co., and broke down in 1914. It would be interesting to know whether the resulting loss to the Council had swallowed up the difference between the price quoted and that of a set of reliable make. We know that certain large A.E.G. turbines installed in this country have turned out so defective that they have had to be rebuilt.

From the foregoing data we deduce the obvious moral which forms the subject of this article—that the cheapest may be far from the best, and may be found the dearest in the long run. The danger of too readily accepting the lowest tender was emphasised by Dr. Ferranti at one of the Beama conferences last winter, and is particularly to be feared in connection with German plant, even though it be made by the greatest of the German companies. In the course of a discussion at the Royal Society of Arts not long ago, Mr. J. Swinburne said that the more the Germans dumped goods into this country, the more we should get in the way of an indemnity; dumping was a splendid thing for the countries that received the goods, and very bad for the countries sending them. But if the dumped goods prove to be more costly in maintenance than higher-priced goods made in this country, even Mr. Swinburne will surely admit that dumping is a bad thing for both parties. In this country we want neither Germans nor German machines; it has been proved that British machines are the better and the cheaper in the end, hence there is nothing to be gained by importing the inferior article.

Patents in War-time.

THE primary object of the law of letters patent is to secure to the public the benefit of new inventions, by inducing inventors to disclose the details of their processes and apparatus, instead of endeavouring to surround them with a veil of secrecy. The inducement offered to the inventor is the privilege of monopoly, guaranteed by the State, for a term of years. Incidentally, by retaining inventors and their discoveries in this country, the public derive advantage not only after the lapse of the term of monopoly, but also during the life of the patent, for employment is given to a number of persons in working the processes, in distributing the products, and in other ways, extending over a wide and complex range; the importance attached to this aspect of the subject by the State is well exemplified by the provisions introduced into the Patent Law a few years ago for the purpose of compelling British patents, not only of native but also of foreign origin, to be substantially worked in this country as a condition of the maintenance of the monopoly.

It would seem, therefore, that the State gets the best of the bargain, and would be acting wisely if it were to offer rewards to the originators of successful ideas, in addition to the monopoly of which so few are in a position to take advantage. But on the contrary, far from recognising its indebtedness to the inventor, the State demands that he shall pay an annual tribute for the privilege of owning letters patent—a tribute increasing from year to year, just as the public benefits derived in other ways from successful inventions increase as time goes on. Surely this is an unjust and unwise policy. At the very least, the State should grant the patents free of charge.

Are we exaggerating the position in favour of the inventor? By no means. The truth of our contention is recognised, confirmed, and published abroad to all the world by the State Government, which has organised several departments for the express purposes of inviting the submission of ideas of all sorts, good and bad—of sifting out the former from the latter with the aid of experts of the highest standing and ability—and of carrying into effect those which afford any prospect of advantage to the nation, at the same time offering rewards to the inventors. Our readers are familiar with the constitution of these departments, which were organised first for the specific purpose of increasing our military efficiency, and afterwards to develop our industrial interests.

Yet side by side with this admittedly revolutionary innovation, the Patent Office pursues its normal course, demanding fees from inventors for the maintenance of their privileges—whilst, moreover, other departments of the Government commandeer factories and workshops, and thus render it impossible for the inventor, during the continuance of the war, to utilise the scanty term of his patent to secure his just reward.

The manufacture of munitions must proceed with the utmost energy, and must take precedence of all private interests; but, at the very least, steps should be taken to suspend the payment of fees for the renewal of patents which are thus hung up, and to prolong the lives of the patents to a corresponding extent.

Our attention has been called to this matter by a letter which appears in our "Correspondence" column to-day; we cordially sympathise with the views of our correspondent, and should be glad to see a movement set on foot to secure justice for the inventor.

Electrical Propulsion of Ships.

ELSEWHERE in this issue we commence an abstract of a paper by Mr. R. S. Portham, which at the same time adds to our information with regard to the Ljungström steam turbine—one of the most interesting and admirable engineering achievements of the age—and bears witness to the growing attention that is being given to the electrical propulsion of ships. This is one of the most important fields that still await conquest by the electrical engineer, hardly second in importance even to the railway field, and the excellent results attained by the s.s. *Mjölner*, in comparison with her sister ship *Mimer*, inspire the confident hope that in no long time marine engineers, for their own advantage, will be compelled to adopt the electrical method of transmission of power from the prime mover to the propeller. The small electrical losses in transit are completely swamped by the gain due to the possibility of adopting the most economical turbines, running at their most efficient speeds, and taking advantage of the latest developments of high steam pressures and high superheat; reversing turbines are dispensed with, and the control is reduced to its simplest terms, while all auxiliaries throughout the vessel, as well as lighting,

heating, and cooking, can be efficiently and cheaply operated by electrical means. We understand that already the application of the system to very large merchant vessels—which, running almost all the time at constant speed, are able to derive the greatest advantage from turbo-electric drive—is in hand, and when the shipbuilding boom which is certain to follow the war commences, we hope that the opportunity will be taken to increase the splendid lead which our merchant marine already possesses over all its rivals, by this means.

Rubber.

The recent setback in the price of crude rubber has proceeded to an extent which has certainly tended to keep the trade demand going at a pretty satisfactory rate considering the rather drastic restrictions imposed by the authorities on the exports to the United States. The reason for this policy is rather obscure, especially in view of the fact that unsold stocks have been accumulating for some time past, while it is understood that proper regulations are in force on the other side under the co-operation of the Consular agents in order to preclude the possibility of leakages in the way of contraband trading with the enemy. However this may be, it is generally inferred that the present restrictions as to permits are merely ephemeral, and must therefore soon or later be modified, or otherwise trade will suffer to some extent. Meanwhile, there is no denying the fact that this adverse feature has had something to do with the recent weakness of the market. Not only have export buyers had to resort to a more conservative policy in the placing of new orders so as to avoid unnecessary additional charges in the way of storage or interest, but the attitude of home consumers has been of a more discriminating character, all of which, including quite large arrivals, have contributed to the depression. Prices, nevertheless, now appear to arouse more interest on the part of consumers, and it is not really surprising that the market is now exhibiting a little more backbone, although there is as yet no robust confidence as to its stability. It is, however, worth noting that the rubber estates are not anxious sellers, and that quotations for forward deliveries covering the remainder of this year have been remarkably well held, mostly at a trifling premium over spot rubber. For the present, dealers are disinclined to carry stock, but it is probable that as soon as the issuance of permits is restored to the normal, a stronger feeling will assert itself and have a stimulating effect upon the general demand. The lower qualities of crepe rubber are now comparatively cheap, and once again attracting a little more attention. The inevitable result of the recent break in the price of plantation descriptions has been an adjustment in values for wild rubber, in which there has not been much activity. The price of fine hard Para has dropped to below 3s. per lb. in the absence of any notable demand, but supplies are fairly well concentrated, and the chances are that, given a revival of buying, the market will readily respond alongside of a change of feeling in plantation rubber. Having regard to the progress of general consumption, the outlook is satisfactory enough, prospects across the Atlantic being quite good, and pointing to the probability of the importations being maintained on a big scale for an indefinite period. American manufacturers have doubtless still good stocks to go on with, so that a temporary falling off in the imports can hardly impair the progress of their operations. As regards the home manufacturing trades, things are now quieter, the pressure of Government work having relaxed, which is enabling the works to make up somewhat for their arrears of deliveries against export orders. The outlet for ordinary cycle tires is, for the time being at any rate, not so large as it used to be.

An Important Detail

It seems that American traders are not so alert as their hustling reputation might lead some people to expect. One of their own Consuls (at Pernambuco) has been writing home emphasising the importance of stating one's telegraphic address and the names of codes used, on letterheads, in catalogues, &c. A case is mentioned of a firm for whom a cable order was waiting, but neither the firm's letterhead nor any available directories gave the information required. Needless messages were in consequence sent, and valuable time was lost, and the business eventually had to be abandoned. This order was not one for electrical machinery or supplies—it was for candies, but the lesson it teaches is the same whatever the article of trade. We need not give the Consul's figures showing the American trader's remissness in the above matter except to state that out of 144 letters examined only 26 gave cable addresses, 50 the address and code, and 68 gave *nothing*. In our opinion the left-hand side of business notepaper can be most profitably occupied by giving essential information of this kind, especially when dealing with buyers abroad. We believe that most of our leading electrical export firms are alive to the importance of such matters. In some cases their catalogues are models of what an export trade publication should be, but the matter wants attention, not only on correspondence paper and in catalogues and trade circulars; it should be especially attended to in advertisements appearing in trade organs. For example, a copy of the Electrical Review lies on the table of a given Consular office abroad—it is to be found on many of them—the Consul receives an inquiry: he turns over our advertising pages and "spots" just the thing the inquirer wants, but the inquiry is an urgent one and the cost of cabling is so many shillings per word. The advertisement gives neither cable address nor code, and the name of the concern is Brown and Johnson's Electrical Accessories Manufacturing Company, Limited, of Little Huddlesdon Works, Partingchester, near Manton—is the inquirer not likely to be discouraged to the point of exasperation if, as is as likely as not, he have no directory of British manufacturers at hand? The illustration may seem an extreme one, but we use it as the simplest way of getting home the need for placing before the buyer essential export trade particulars. Whether the inquirer be a trader in a big business centre, or a caller at the Consulate, or a buyer in an out-of-the-way corner of the globe, when he gets the Electrical Review with the complete trade advertisement in it, he will find it a time-saver and the advertiser will get business which might otherwise pass him by. We have no first-hand figures available concerning the practice followed in British export papers as a whole, but the American Consul gives some interesting information that he has compiled as the result of a survey of the advertisements in a number of publications. He does not say whether these journals are all American; we should judge that they are not so, for the weakness is certainly not peculiar to the States. He says:—

> One of the best-known export journals circulating in Central and South America contained in a recent issue 135 advertisements, and of these 9 had address and code, 4 address only, and 122 no telegraphic information. The same is true of the announcements in other export magazines. Of 70 machinery catalogues examined, 10 gave address and code, and, in addition, their own private code; 15 gave address and code; 5 gave address only; 4 gave private code only, failing to state cable address and other codes used; 36 gave no telegraphic information.

ELECTRICAL EQUIPMENT OF THE PHŒNIX ASSURANCE CO.'S BUILDING.

One of the finest of the recently-completed modern London office buildings is that erected for the Phœnix Assurance Co., in King William Street, E.C., which houses not only the company's own staff, but also the Bank of Egypt and certain other tenants. The building, which is in the classical Renaissance style, covers an area of 12,000 sq. ft., and is eight storeys in height, the two lower storeys being basements.

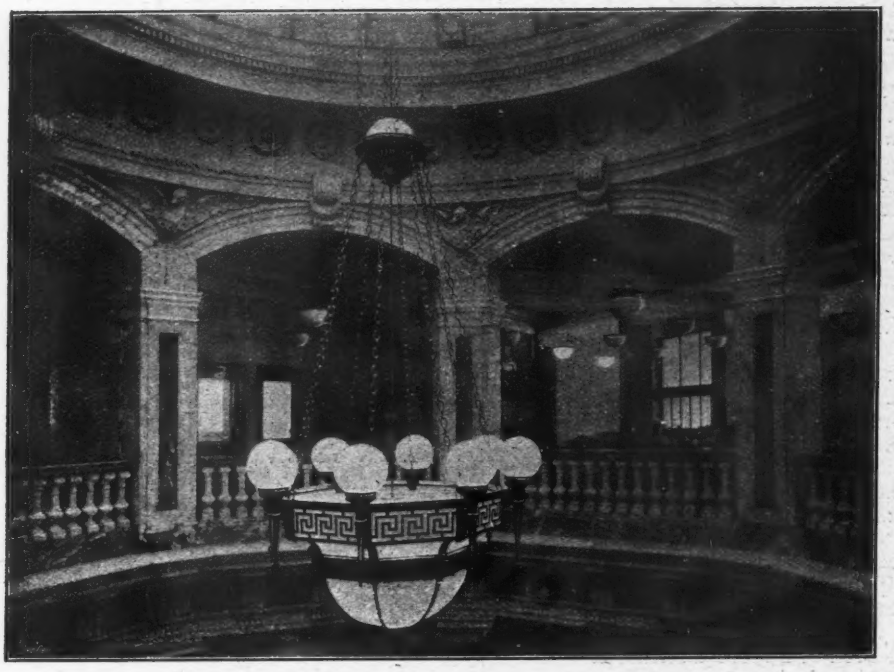


Fig. 1.—Large Central Fitting, Phœnix Assurance Building; also Indirect Office Lighting.

The consulting engineer for the whole of the electrical work in connection with the building was Mr. S. G. Castle Russell, M.I.E.E., who has courteously allowed us to place on record the principal features of interest in the installation.

Although the services to, and installations in the Phœnix Company's premises, and those of the Bank and east and west ends (tenants' portions), &c., are kept distinct, the general type of installation is uniform throughout and can be gathered from the description of the work carried out at the Phœnix Co.'s premises, which follows.

The electric supply for the whole of these premises is controlled from a switchroom in the sub-basement, this supply at 400 volts being obtained from two independent sources, viz., the Charing Cross and City of London Electric Supply Cos., and this division of service is carried out wherever practicable throughout the whole building, approximately half the lighting in all large or important rooms and on each floor being supplied by each company, and the well pump, ventilating, lift and pneumatic tube motors being served by both companies as a precaution against total interruption of the supply. The switchroom is a departure from usual practice, the main switchboards being built up of ironclad gear attached to the glazed brick walls, with the interconnecting cables carried in heavy-gauge screwed gas barrel, with rectangular cast-iron junction boxes.

On entering the switchroom, each company's service — the neutral being divided — is led to two two-way terminal boards (positive and negative) through a 350-amp. D.P. switch and fuses.

From each terminal board a 200-amp. service is led through a D.P. switch and fuses to a 200-volt main distribution board for lighting, fitted with D.P. switches and fuses for controlling individual services to the various floors and basement and sub-basement; a 100-amp. heating service is also taken off, similarly controlled in each case by a D.P. switch and fuses — these services running in the case of one company to

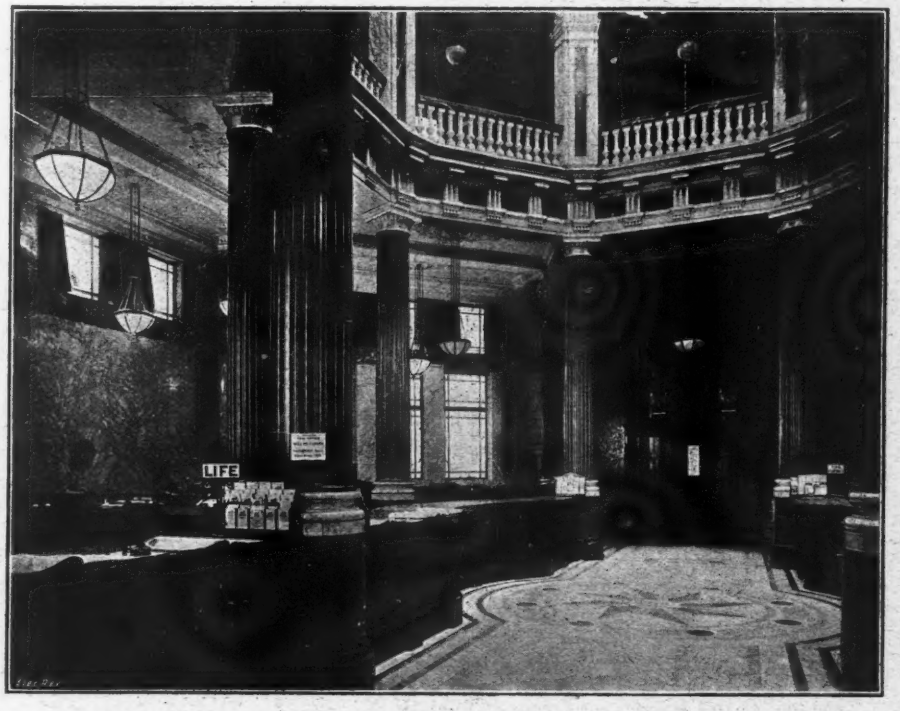


Fig. 2.—Phœnix Assurance Co.'s Offices, showing "Half-Watt" Indirect Lighting.

the ground and fifth floors, and in the case of the other to the first and second floors.

From the outers of each pair of terminal boards a 200-amp. power service is taken to a main power distribution board, fitted with D.P. switches and fuses, which controls the various motor circuits in the building; each of these

FIG. 3.—VIEW IN BOARD ROOM, SHOWING SPECIAL LIGHTING FITTINGS.

boards is also controlled by a D.P. switch and fuses in the switchroom.

The pair of lighting distribution boards on each company's service are on facing walls, but all the heating and power circuits are in close proximity.

As previously mentioned, the switchgear is of the ironclad pattern throughout, the D.P switches being mounted on marble bases, two inches clear of the case all round for the main switches which are lined with Uralite, and three inches clear in the case of the main distribution boards which are also Uralite lined and have plate glass fronts and front bus-bars.

The whole of the switchgear is white enamelled and clearly labelled; its general appearance is shown in figs. 4 and 7.

To provide for the services to the various floors, four chases are provided running from bottom to top of the building; and adjacent to the chase on each floor are provided sub-distribution fuseboards and D.P. switches of the ironclad type, as shown in fig. 8.

The whole of the wiring, as far as possible, is carried out on the looping-in system, special cast-iron looping boxes with porcelain interiors being provided where necessary. This wiring, consisting of 2,500 meg. braided V.R. cable, is run throughout in heavy gauge-screwed galvanised gas barrel, which was erected complete, with the plaster in position, before any wire was drawn in.

Cast-iron junction boxes with screwed lids are provided where necessary and similar boxes are used in place of tee-pieces and elbows throughout.

All the lamp-fittings, switches, &c., are screwed direct on to the iron junction boxes connected to the tubing, and the ends of all tubes throughout the installation were fitted with brass bushes, screwed on before the wire was drawn in.

The method of illumination adopted is of particular interest owing to the extent to which semi-indirect lighting is being used.

The imposing ground floor office depends entirely on the light provided by twenty-two 100-watt half-watt lamps in diffusing bowl reflectors suspended from the ceiling, as shown in fig. 2. In addition, a large central bowl-fitting is provided on a level with the gallery under the dome, which is a feature of the ground floor office; this fitting contains a 150-watt half-watt lamp in the bowl, with 60-C.P. lamps in spherical globes round the periphery, as shown in fig. 1, which also shows the semi-indirect lighting in part of the actuarial department. The illumination of the counters of the ground floor office is from 3 to 4 ft.-candles, while that of the desks behind varies from 4 to 6 ft.-candles.

The suspended bowl type semi-indirect lighting fitting has been generally adopted throughout the building, having been specially designed by the makers in bronze and in Georgian style, to harmonise with the principal apartments.

In all, we understand that some 1,200 lamps of from 20 to 100 watts each have been installed in the building.

Turning to the other matters of electrical interest, an extensive mechanical ventilating plant has been provided, which includes a 25-in. motor-driven fan for forcing fresh air into the basement and sub-basement, the incoming air being passed through the heating chamber in order to slightly warm it in the winter; a 15-in. motor-driven fan for extracting used air from parts of the basements; two 25-in. motor-driven fans for extracting air from the upper floors and several smaller extractor fans in various positions.

The general heating of the building depends on hot water radiators, fed from boilers in the basement, but this is supplemented by a number of 1,500-watt electric radiators, each controlled by D.P. iron clad switch and fuse and plug.

The water supply for the building is obtained from two artesian wells, bored to a depth of 450 ft. below the lower basement level. Each well is provided with its own electrically-driven pump and each of the latter will supply about 12,000 gallons, or the estimated requirements for one day, with eight hours' running. The water is raised in two lifts to storage tanks on the roof of the building.

The Phœnix premises proper are equipped with two Waygood-Otis electric passenger lifts placed centrally; three other lifts of a similar type are also provided to

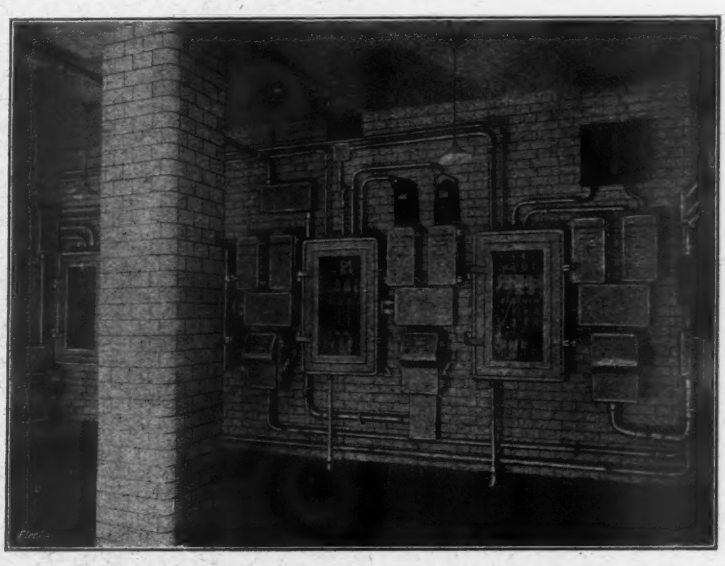


FIG. 4.—VIEW IN SWITCH ROOM, SHOWING MAIN DISTRIBUTION BOARDS, &C.

serve the Banking and other tenants in other parts of the building.

A small electric cooking installation, comprising some 35 KW. of Jackson equipment, is installed on the fifth floor.

This apparatus, shown in fig. 6, includes a double oven with hot-cupboard between, and a boiling plate with six rings over it; a grill with hot-cupboard over it; stock pot, fish

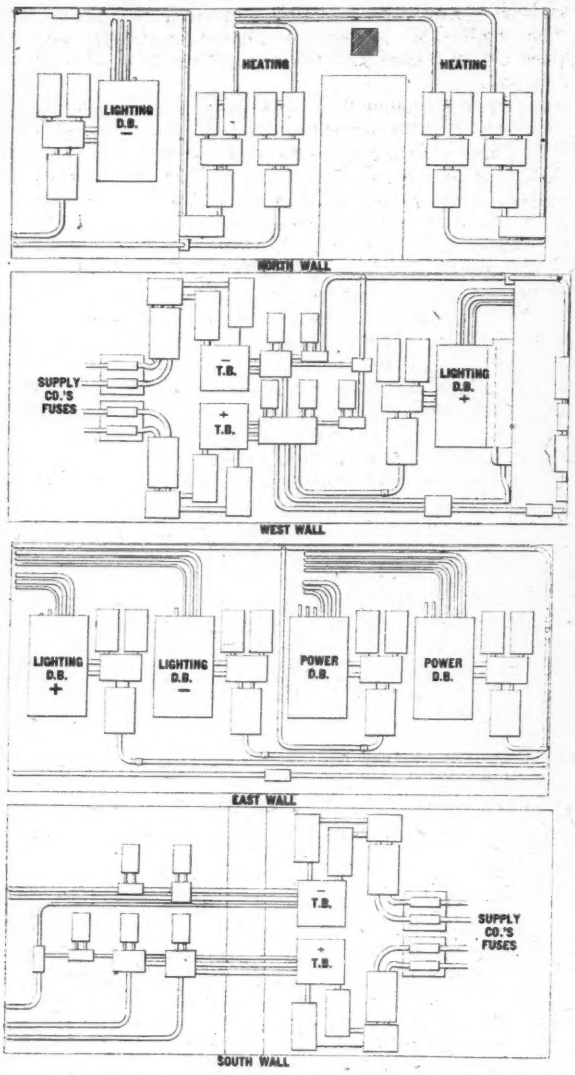


Fig. 5.—Diagrammatic Arrangement of Ironclad Switchgear in Switch Room.

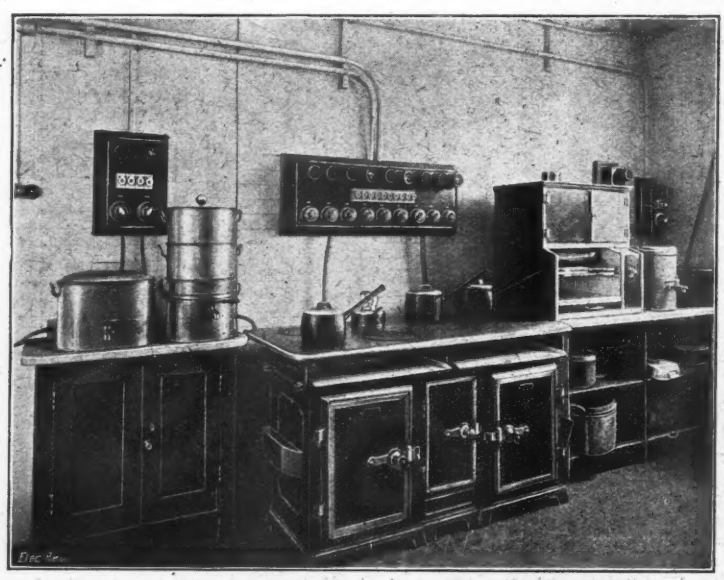


Fig. 6.—Electric Cooking Apparatus in Kitchen.

fryer, tea and coffee urns, &c., the average week-day requirement being from 17 to 31 dinners and 70 teas.

A private telephone exchange is also provided in the building, this consisting of two 50-line P.O. boards and a 120-line private internal board. There is also a very complete electric-bell installation for the inter-departmental use of the Phœnix Co.'s staff.

The principal contractors in connection with the carrying out of the work for light and power wiring were: Phœnix Co.'s offices, Messrs. Belshaw & Co.; tenancies and Bank of Egypt, Messrs. Finch & Wheeler, which firm also carried out the internal telephones and electric bells. The special electric light fittings were designed and supplied by Messrs.

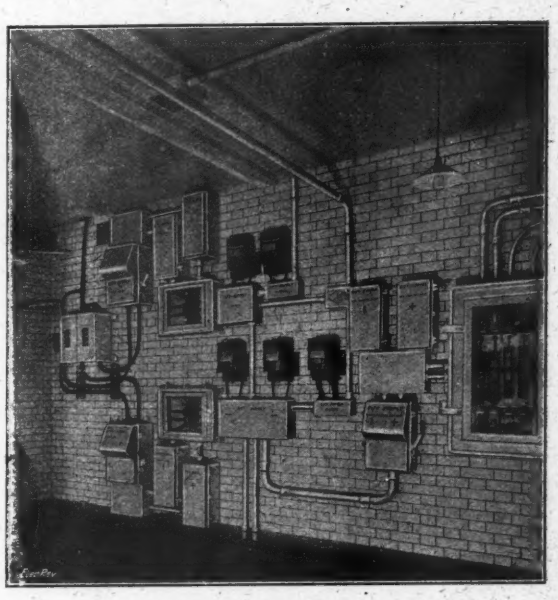


Fig. 7.—View in Switch Room.

Veritys, Ltd., who also were responsible for all the ironclad switchgear and motors. The ventilating plant was supplied by Messrs. Strode & Co.; and Messrs. A. Williams & Co. were responsible for the artesian-well work, under the supervision of Mr. Albion T. Snell.

As previously mentioned, the whole of the electrical work was carried out under the direction and supervision of Mr. S. G. Castle Russell, M.I.E.E., who was also responsible for the electric lifts, low-pressure hot water and ventilating systems; and Mr. C. W. Catt acted as clerk of works for the whole installation.

THE ELECTRIC COOKER IN INDIA.

By CHARLES S. JEFFREY, A.M.I.E.E., A.Amer.I.E.E.

In reviewing the possible applications of electricity for domestic cooking and heating in India, we may leave out of consideration the greater part of the population. There can be no question whether the poorer classes will ever use electricity in their homes, because these people live in a state of poverty unknown in colder climes. Perhaps "poverty," which suggests distress, is not the best word to use; although the majority of Indian natives have the absolute minimum of worldly possessions, they are usually happy and contented. "A state of simplicity" better describes their circumstances. One does not expect to find electric fittings in a bamboo hut, or in a shed made of old kerosene tins, where the entire furnishings consist of a mat on the floor

and one or two cooking pots, and, perhaps, a few treasures in the shape of empty cigarette tins or the illustrated calendars of bygone years.

It is only necessary, therefore, to consider the classes who use or are likely to use electricity for lighting. In one of the largest towns in India, where there is no gas supply, the number of consumers on the supply company's mains is only 1 per cent. of the total population. This number includes all business premises. Of course, in India the number in each household is usually greater than in England, but the total number of users of electricity is not likely to exceed 10 per cent. of the population in the large towns.

It is the custom in all European and the better-class native households, in which may be included all those wherein electricity is used, to keep a cook. In most self-contained residences the kitchen is situated a short distance from the main part of the house, with a covered way between the two. The advantages of this arrangement in a hot country are obvious, but it has the effect of isolating not only the kitchen, but also the cook from the rest of the household. The kitchen becomes not so much a part of the house as the abiding place of the cook; its usually gloomy fastness is seldom invaded by the mistress of the house, and, except on a punitive expedition, by the master, never. To the careful housewife in England it may seem incredible, but very few Memsahibs visit their kitchens more than once per day, and many not once per week. And perhaps it is better so.

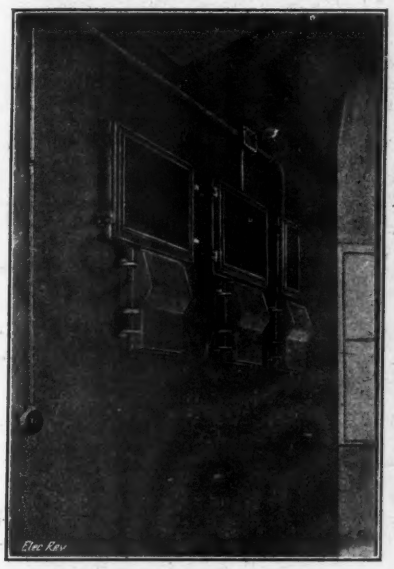


Fig. 8.—Typical Set of Sub-distribution Boards and Switches.

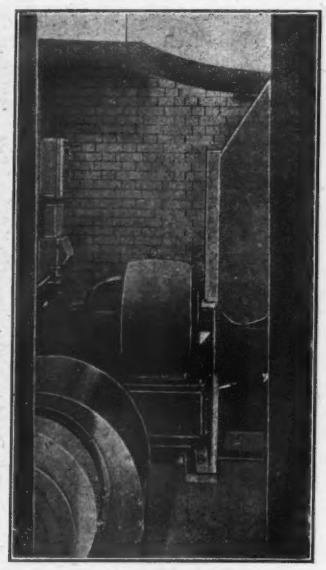


Fig. 9.—Ventilating Plant in Basement.

Phœnix Assurance Co.'s Installation (see page 500).

Be as enthusiastic as they may, it is not possible for white women in the East to do much work in the house if they take proper care of their health. It is evident, therefore, that no matter what appliances are used, the greater part of the cooking must be done by the native cook.

The writer may be unduly pessimistic, but he fears that the task of educating Mr. Dorosawmey in the economical use of an electric cooker is an insuperable obstacle. If one could be certain of keeping one's cook, it might be done, but it is likely that the knowledge that he alone could operate the cooker would give the cook courage to become more and more extortionate in his daily bazaar accounts. It is seldom that one keeps a servant for more than a year in India, and good cooks are usually the most difficult to retain.

In Rangoon the cooking is usually done on a charcoal fire. The writer, who had a coal fireplace in his kitchen, had the greatest difficulty in persuading the cooks to use it, and whenever a dish was spoiled the cook invariably blamed the fireplace. A letter received from one of our cooks may be of interest. The errors in spelling are omitted:—

> highly respected memsahib with due respect and humble submission this petition humbly sheweth that your petitioner is a poor man and humbly requests you to forgive the trouble your ladyship is my father and my mother and my children and their children look to you for bread I good cook man and my father good cook man and pray that your ladyship will have pity on my hard case my father cook with charcoal and his father cook with charcoal madras cookman cook with charcoal bombay cookman cook with charcoal memsahib say cook with coal fire not can do I giving notice leaving at end of month by your favourness have pity on my hard case my children will have no bread for which act of kindness shall ever pray for your ladyship's long life and happiness please I waiting your ladyships reply your most obedient servant cook dorosawmey.

It should be remembered that native servants spend all their spare time, of which they have much, gossiping about their mistresses and the doings in the households to which they belong. Should the electric cooker one day develop a fault and reveal the thousand devils of which it is possessed, the news would go round to every cook in the town, and no eloquence would prevail on one of them to touch it again. Everyone connected with the business of electric supply in India knows that if a native receives an electric shock he vanishes "like the snowfall on a river" and the place thereof knows him no more.

In support of cooking by electricity, much has been written about the saving in weight effected by roasting joints in an electric oven, but the opinion seems to be gaining ground that this saving is really due to cooking at a lower temperature, and the only advantage attributable to the electric cooker is the closer regulation that can be effected. A study of Indian methods of cooking supports this theory, as one cannot fail to observe that the apparatus used appears to be of comparatively little importance. A good cook will prepare the most elaborate meal with the most primitive utensils. The cooking place in a typical Indian kitchen consists of a square of brickwork in which are made several small charcoal fireplaces, about 6 in. square and 4 in. deep. That is the whole permanent equipment of the kitchen. There is no oven provided. If the cook wishes to be disagreeable, he may insist on having a portable cast-iron oven which he can place over one of these fireplaces, but usually all the baking and roasting is done in an old kerosene tin. Most cooks will bake excellent cakes in a stewpan only a little larger than the cakes themselves.

She who presides over the writer's household informs him that to cook well, one must cook slowly. Undoubtedly herein lies the secret of the Indian cook's success. He is superlatively slow. To his credit, it must be said that he also has infinite patience. For example, when baking a cake he will surround his kerosene tin or stewpan with glowing charcoal, and will stand over it from the moment the cake is put in until it is taken out, carefully fanning the fire and readjusting his charcoal, piece by piece, in order to concentrate the heat just where it is required. So long as the cooks stick to these methods, and that is probably as long as the present generation of them survives, it is unlikely that much progress can be made in the adoption of electric cookers for general purposes.

In India, another very important drawback from

the supply company's point of view is that the principal meal of the day in all European and better-class native houses is served between seven and nine o'clock in the evening, and since, in India, even in the northern provinces, there are no long evenings such as we are accustomed to in the summer months at home, it is invariably served after dark. This means that the peak cooking load would almost coincide with the peak lighting load, and with a poor diversity factor it is, of course, impossible to offer very attractive rates.

So far this article is so pessimistic that it is, perhaps, more suited to the pages of the *Journal of Gas Lighting* than those of the ELECTRICAL REVIEW, but the writer hastens to add that there is a brighter side to the picture. Although there is not much likelihood of electric cookers being adopted for general purposes, their cleanliness and freedom from external radiation make them valuable auxiliaries for domestic purposes. Apart from the attitude of the cook, the isolation of the kitchen and its uncomfortable environment are sufficient to deter most Memsahibs from practising the culinary art; but if the home is equipped with a small electric cooker which can be fitted in the dining room or verandah, there is no reason why the husband domiciled in India should any longer be free from the danger which is reputed to lurk in his young wife's first cake. There are many people who cannot enjoy food prepared by the native cook, because they know too much about his methods, and electric cookers make it possible for them to prepare an occasional meal for themselves.

Once an electric kettle has been used in any household it becomes indispensable, not only because of its convenience at the tea table, but because it provides a means of obtaining hot water after the cook has departed from the kitchen. Electric toasters also are in great demand. Even those of us who accept all that comes from the kitchen, provided it passes the test of smell and taste, without permitting our imaginations to dwell on disagreeable possibilities, enjoy our toast better when we have positive knowledge that the hands which prepare it are clean.

When we leave the kitchen for the laundry, we find another invaluable article to be the electric iron, because by its use it is possible to save many delicate fabrics from that ruthless destroyer, the dhoby or washerman. The dhoby's method of washing is to dip the article to be cleaned into a bucket of soap and water, swing it round his head, and bring it down with a smack on a block of wood or a flat stone. If the wood has a nail in it, what cares he? Mark Twain described him as the man he saw "breaking stones with a shirt."

When ironing, in order to impart to the clothes the moisture which we are told is necessary to obtain a good surface, he uses his mouth as a reservoir and ejects water upon the garment with an accuracy of expectoration that no Englishman and few Americans could equal. Fortunately for their peace of mind, many Memsahibs are in ignorance of this little practice of the dhoby's, because the ironing is usually done in his own quarters. When an electric iron is part of the household equipment, it is possible to have the more delicate articles washed and ironed under the eye of the Memsahib. Even if the dhoby will not do the work in this way, there are few women who will grudge the time it takes to do a little laundry work for themselves, when by so doing they are spared the distress of witnessing the rapid disintegration of their most cherished "chiffons."

In the rainy season small electric heaters are very useful for drying out wardrobes, cupboards, &c., and thereby preventing much destruction by mould and mildew. In many pianofortes a carbon lamp or small heater is permanently fitted for this purpose. Obviously, in a hot country it is essential for comfort that the heat should be localised to the articles to be dried, and the advantage of the electric heater in that connection is at once apparent, since it can be used in situations where any form of combustion heater would be out of the question.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

"Doing His Bit."

We sing of Tommy Atkins, the "man behind the gun,"
Of workers in the factories, making bullets by the ton;
But think of the man in the power-house, amid the turbines' roar,
For there he's doing his duty, they'll let him do no more.

He cannot join the Army, they say he can't be spared;
They won't put him in khaki, for then he'd not have cared.
He's trying to do his little bit, it isn't much, I know,
It's one of those silent, unknown jobs that doesn't get much show.

Men from munition factories pour out each day in streams,
But they would be no good at all if they weren't supplied with means
To turn their massive turret lathes and make the motors run,
But they get the extra cash, while the other chap gets none.

The man who runs the power house works seven days a week,
He gets no overtime, but has to pay more for his keep;
And when "Take air-raid action" comes he has to do his bit
For the safety of the public, and the chance of getting hit.

So when you pass a power house and hear the turbines hum,
Give a thought to the man inside, whose work is so hum-drum.
He isn't a khaki hero or a sailor boy in blue,
But his King and Country need him, and he'll see his duty through.

P. Gordon Hieatt.

York.

Justice to Inventors.

Whilst to many in this country the war has brought increased work and remuneration, there are others who have been very hardly hit, and none, I venture to say, more than inventors and patentees.

Before an invention reaches the stage when it begins to bring in a return, a large amount of work, trouble, time, and money has, as a rule, been expended on it.

When the war broke out, there must have been large numbers of engineers, and others, owning patents which had just reached the stage at which it might reasonably be expected that the income to be derived from royalties or sales would begin to repay the time and money expended in development.

In the majority of cases, alas! the inventors soon found that, owing to the works being required for munition purposes, it was no longer possible to manufacture their patented articles, and their royalties fell off very considerably, or in many cases ceased altogether.

Under these circumstances, it seemed a natural step to ask the Patent Office to postpone payment of the renewal fees, and to prolong the life of the patent by a period corresponding to the duration of the war, or to the time during which the pressure of Government work rendered it impossible to manufacture the patented article.

The reply of the Patent Office is, however, that they have no power to grant either request, and that, as far as the Office knows, no fresh legislation is contemplated.

It is, of course, always open to any patentee at the expiration of the life of his patent to apply for an extension, but what assurance has he that his application will be favourably received? Meantime, he must either drop payment of the renewal fee, and thus forfeit his rights, or pay the fees in the hope that after the war is over his application for an extension of his patent may receive favourable consideration.

Now, Sir, this is neither justice, nor in the public interest.

It is, surely, not just that the Patent Office should take fees from inventors when, owing to the needs of the nation, it is impossible to get the patented articles made; nor can it be in the public interest to discourage inventors in this way.

In the industrial war to which the nation is committed we shall need to utilise to the very utmost all the inventive skill of our people, and we cannot afford to risk the loss of useful inventions simply because inventors, owing to want of proper support, cannot afford to nurse their ideas through to fruition.

Even if the inventor does receive any royalties, the authorities show their appreciation of his work by demanding the payment of income-tax at the full unearned-income rate without allowing any deduction for development expenses.

May I beg, Sir, the hospitality of your columns to ventilate the matter, in the hope that a body of public opinion will be formed sympathetic to securing fair play and encouragement to our inventors.

Fair Play.

[We refer to this matter in our leading columns to-day.—Eds. Elec. Rev.]

WAR ITEMS.

German Goods in New Zealand.—The "Auckland Weekly News" publishes the following:—"A trade catalogue has been shown to a Dunedin reporter which states explicitly of a certain magneto that it is manufactured in America. The old German-looking title of the company is replaced by a word that is characteristically American, and the catalogue expressly states that the concern is purely of American make. So one would also gather from the lettering on the cover of this magneto 'Made in the United States of America.' It is this lettering that the customer reads, probably he looks no further, but the repairer, in remedying defects, looks inside. It was in the course of such an examination that a repairer found a betraying brand on the magneto 'made in Germany.' The outer lettering, in small type and newly cut, declares that the magneto is made in America, the inner and bolder and older inscription inside states that the make is German. Information placed at the disposal of the reporter leads to the belief that such magnetos are still being imported into the Dominion, via America."

Controlled Works.—The number of establishments controlled by the Ministry of Munitions has been increased by 156 to 3,493.

Exports to Liberia.—In the "London Gazette" for April 28th there is published a list of persons authorised as consignees of articles exported to Liberia.

To be Wound Up.—Under the Trading with the Enemy Amendment Act, the Board of Trade has ordered the following to be wound up:—Alphons Custodis Chimney Construction Co., Ltd., 119, Victoria Street, London, S.W.; constructors of chimneys, &c.; controller, D. H. Allan, 20, Copthall Avenue, London, E.C. The Phonotas Co., Ltd., 125, High Holborn, W.C.; sanitary system for cleaning telephones; controller, Alfd. Hartley, 9, Ironmonger Lane, E.C.

Trade After the War.—A Reuter dispatch from Sydney states that the annual conference of the New South Wales Chamber of Commerce has unanimously passed a resolution in favour of the encouragement of trade within the Empire, recommending among other things the imposition of a surtax on enemy goods, and also that enemy goods after the war shall be indelibly marked with the name of the country of origin.

The Chairman of the General Steam Navigation Co. says that in considering the question of new tonnage, a great factor must necessarily be how far and how long the bitter feelings engendered by the war would be extended after its close to commercial intercourse between the belligerent nations. As reported by the "Evening News," he added: "I think that trade between this country and Germany will be vastly reduced in volume—for sentimental reasons because the British will not easily forget the many acts of ruthlessness of which the Germans have been guilty, and for economic reasons because the spending power of this country and the Central Powers must be restricted for years. It is clear that additional revenue to meet our indebtedness must be sought from other sources than direct taxation, and those will be found in the imposition of duties on all imported manufactured goods. It is not to be assumed that a complete commercial boycott of the Central Powers will be effected, as, in my opinion, international business is too interlaced to make this either possible or desirable."

At the close of the International Inter-Parliamentary Commercial Conference in Paris (says a Reuter dispatch in the "Morning Post") the meeting unanimously adopted resolutions regarding the following:—(1) The establishment of preferential postal, telegraphic, and telephone rates between the Allied nations. (2) The constitution of a permanent body charged with determining the conditions of the transport of merchandise and the introduction of a tariff on enemy goods so as to avoid delays in the transport of goods from Allied States. (3) Reduction of freight rates, with recourse if necessary to general requisition of merchant vessels with indemnification in order to assure victory by the economic solidarity of the Allies.

Exemption Applications.—At Maidstone, on April 25th, the manager of the Corporation tramways renewed an appeal for exemption for three car-drivers. A month ago the matter was deferred to see if ineligible men could be found, and Mr. Lambert now said that he had engaged a discharged naval man and a discharged military man, but two other drivers had left, and he was in the same position as he was a month ago. Next month, however, he expected two discharged army men formerly in the service of the Corporation. One man, who has been on the tramways since the opening, was conditionally exempted; the cases of the others were put back until May 25th.

Before the West Kent Appeal Court, on April 27th, an appeal by Mr. J. Vince, electrician at the Turkey Paper Mills, Maidstone, for exemption, was refused.

At Ryde (Isle of Wight), the Isle of Wight Electric Light Co. applied for exemption for a shift engineer and fitter in sole charge of the engines and electrical plant while running, and claimed to be indispensable. The tribunal granted conditional exemption.

The Rugby tribunal has granted conditional exemption to an employé of Messrs. Willans & Robinson, who wished to go to Nigeria to erect machinery at tin mines there.

Before the Devon Appeal Court, on April 26th, an appeal was made for an electrical engineer and wireman employed by Messrs. Garnish, Lemon & Co. The local tribunal had refused exemption, considering that the appellant was not indispensable to the business. The tribunal granted adjournment until applicant's group was called up.

At Wallasey, on Monday, Colonel Greene, tramways manager, applied for further exemption for 28 married car drivers. The tribunal decided to defer consideration of all married men's cases until single men "combed out" of reserved occupations had been dealt with, and granted conditional exemption for one month to all the married tram drivers. An appeal was also made for the exemption of a motor controller, single, aged 36, who was stated to have taken the place of a skilled man, and who was essential for the maintenance of the tramway service. It was remarked that the man came under the head of those engaged on the maintenance and repair of plant and machinery, but a member of the tribunal said that the skilled man had been allowed to go and the handyman had taken his place, whereas the handyman ought to have been allowed to go at the onset, and not the skilled man. The appeal was disallowed.

Trading with the Enemy.—The "London Gazette" for May 2nd contains further additions and amendments to the lists of persons or bodies with whom trading is prohibited in Argentina, Brazil, Chile, Netherland East Indies, Norway, Philippine Islands, Portuguese East Africa, Spain, Sweden, &c.

Exports to China.—The "London Gazette" for May 2nd contains further lists of persons and bodies in China and Siam to whom exports may be consigned.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Annual Report, &c.

The report of the Council for the past year is published in the issue of the *Journal* for May 1st. It states that the membership at April 1st was 6,676, showing a net decrease of 141; additions during the year numbered 212 (including 142 Students), and deductions 353 (79 deceased, 96 resigned, and 178 lapsed). Members numbered 1,500, Associate Members 3,466, Associates 520, Graduates 382, and Students 801, the remaining 7 being Honorary Members. During the year 49 candidates for Associate Membership, of whom 27 were non-members, were approved by the Council subject to complying with the examination regulations. The Council elected M. Maurice Leblanc an Hon. Member, and the King conferred a baronetcy on Sir H. Norman, M.P., K.C.B. upon Lord Moulton, and knighthoods upon Sir W. Slingo and Sir G. Franklin. Numerous military distinctions were awarded to members, including the Victoria Cross to Lieut.-Com. E. G. Robinson, R.N., and 34 members lost their lives in the war. Other members deceased included Mr. C. E. Spagnoletti, Prof. E. Gerard, Mr. Robt. Hammond, Lord Alverstone, Mr. E. Danvers, Mr. H. A. Mavor, Sir A. Rücker, Capt. E. G. Tidd, Mr. F. H. Varley, and Mr. Thos. Parker.

On account of the war, the annual dinner and conversazione will not be held this year.

Premiums for papers have been awarded to Messrs. J. R. Beard, H. H. Harrison, N. W. Storer, A. Campbell and D. W. Dye, A. E. Clayton, and Professors A. B. Field and G. W. O. Howe. No Students' premiums have been awarded, and the David Hughes and Salomons Scholarships will not be awarded this year.

Twenty-two societies have held meetings at the Institution.

The Wiring Rules have been revised, 24 meetings of the Committee having been held and over 500 amendments considered; no fewer than 13,500 copies of the 1911 edition were issued, and the seventh edition has been adopted by the whole of the fire insurance companies of the United Kingdom.

The Council applied to the Committee of the Privy Council for grants for research, and has received £840 for a year's

work on the heating of buried wires, and £250 for research in the properties of insulating oils; Mr. J. S. Highfield has been appointed representative of the Institution on the Engineering Committee of the Advisory Council for Research.

The number of members that are or have been serving in the Navy or Army since the outbreak of war is over 1,300. The Council has taken steps towards facilitating the employment of disabled soldiers and sailors in electrical undertakings, and arrangements are in progress to that end; a guarantee fund of over £300 has been established for the purpose by past and present members of Council.

The accounts show a surplus of income over expenditure of £1,847, compared with £1,623 in 1914. The assets amount to £116,748, against liabilities £43,013, leaving a balance to the good of £73,735, an improvement of £2,165; the building fund amounts to £43,946, and the general fund to £23,619.

At the end of 1915 the capital account of the Benevolent Fund stood at £4,642; donations and subscriptions amounted to £777, and seven grants were made, amounting to £126.

The same issue of the *Journal* contains a further list of promotions, transfers, &c., of members on military service, and the result of the "voting" on the proposals adopted by the informal meeting of Corporate Members on March 8th. The number of cards issued was 3,244, and of these 1,470 were returned. The proposals were as follows:—

	For.	Against.
(*a*) To expel members who are subjects of enemy countries or States	1,320	88
(*b*) To expel members who being naturalised British subjects have retained enemy nationality	1,307	79
(*c*) *Not* to expel members who are naturalised British subjects and were formerly subjects of a country or State now at war with Great Britain and Ireland but who have under the laws of such country or State definitely lost their alien nationality, provided they are able to prove this to the complete satisfaction of the Council	1,081	264
(*d*) That no person shall after the.....day of ....., 19..., be eligible for election as a member of the Institution who is a subject of any country or State with which the United Kingdom of Great Britain and Ireland is or shall have been at war on or after the date mentioned	1,120	200

A resolution has been drafted to carry out the objects proposed, and in due course the necessary meetings of Corporate Members will be called to consider it.

The ballot paper for the election of Council has been issued; the list of names is identical with that published in our issue of March 31st, with the exception that the name of Mr. C. H. Wordingham has been added to those of Messrs. R. A. Chattock and J. S. Highfield as candidates for election as Vice-President, on the nomination of 17 members, whose names are given, in accordance with the Articles of Association.

The annual general meeting will be held on Thursday, May 11th, at 8 p.m.

SHANGHAI ELECTRICITY REPORT.

The annual report of Mr. T. H. U. Aldridge, engineer-in-chief of the Shanghai municipal electrical undertaking, for the year 1915, shows that continuous progress is being made, and that the forecasts of previous years are in process of realisation.

During 1915, 49,787,397 units were sold, including, roughly, 14 millions for private lighting, 1 million for public lighting, 680,000 for heating, 30,633,455 for power, and 3,395,813 units for traction; the total represents an increase of 52 per cent. on the 32,633,671 units sold in 1914, and the power units included show an increase of 101 per cent.

The public lighting output showed a slight decrease, although over 100 additional lamps were connected, this being due to the general use of the nitrogen-filled metal lamp.

The maximum load on the feeders, 14,000 KW., was under the amount estimated at the beginning of the year, due to the temporary suspension of running of some large mills, and to a number of small consumers shutting down owing to trade depression. The load factor improved from 33·6 per cent. in 1914 to 40·8 per cent. in 1915. The total H.P. of motors on the mains now amounts to 14,547, representing a net increase of 2,365 H.P. during the year. The report points out that 6,210 H.P. of motors in 10 different oil, flour, and cotton mills have been negotiated for in the coming year.

As to heating and cooking, 1,216 radiators, of 2,432 KW. capacity, are now connected, practically all hired out by the department at 1s. 3d. per month.

This form of heating has become popular amongst foreigners and Chinese alike, but electric cooking has been held back because the cooking ranges ordered could not be procured. It is found that 2 KW. is the minimum satisfactory size of heater in Shanghai.

At the end of the year there were 44 arc and 1,422 metal lamps in use for street lighting and practically all the latter are of the nitrogen-filled type, in 60-C.P. to 400-C.P. sizes. During the typhoon last summer, in several cases the street lighting was interrupted by branches of trees falling upon or among the wires forming the street lighting circuits; the typhoon was, however, of exceptional severity, and Mr. Aldridge points out that failures are rare and the price paid for the lighting service is very low. There were 16,992 meters and 1,092 current limiters in use at the end of the year, and 18,104 connections to the mains.

The generating plant capacity in use at the two stations (Fearon Road and Riverside) was 19,600 KW.; 62,291,443 units were generated, the modern Riverside plant providing 54,845,415 units.

The works cost per unit fell to ·534d.

The net increase of transformer capacity for the year was 5,394 KW., bringing the total transformer capacity in use to 18,284 KW. A new sub-station in Tonquin Road has been completed and partly equipped; it will ultimately be supplied with 6,300 and 22,000-volt current and have a capacity of 15,000 KW. Seven three-phase sub-stations for an ultimate capacity of 10,000 KW. are under construction.

Financially, the undertaking made a net profit of £32,363, after providing £27,877 for loan interest and £38,087 for depreciation. The profit represented 8·91 per cent. on capital outlay, having increased from 6·98 per cent. in 1914. The profit for 1916 is estimated at £39,567, and £44,573 will be set aside for depreciation.

The report contains a short description of the new Riverside extensions, to which reference has already been made in our pages.

The present type of steel frame building with corrugated iron walls will be adopted, with a turbine room 90 ft. long by 60 ft. wide, and a boiler house 130 ft. long by 90 ft. wide. Coal bunkers will provide accommodation for 1,000 tons of coal, and will be supplied by coal-handling plant with a capacity of 60 tons an hour, either direct from an 11,000-ton coal store or from river barges.

A 20-ft. bay containing pumps, fans, &c., will separate the turbine and boiler rooms, and a separate reinforced-concrete switch and transformer house will be provided.

Two 10,000-KW. turbines (by Parsons and the G.E.C. of America) and a 5,000-KW. turbine set (Fraser & Chalmers-Vickers) comprise the first installation, and these will operate on 180-lb. steam superheated 200°. The alternators are to generate at 6,600 volts, three-phase, and by means of step-up transformers direct-connected to the generators, the pressure will be raised to 22,000 volts.

The transformers are designed with 5 per cent. internal reactance, and the use of external reactance will be avoided.

The 5,000-KW. turbine set will run at 3,000 R.P.M., and have a full-load steam consumption of 13 lb. per unit, while the 10,000-KW. Parsons turbine unit (1,500 R.P.M.) will operate on full load with 11·9 lb. per unit, the American turbine of the same size and speed, but of the impulse type, being rated at 12·85 lb. steam per unit; the latter machine was adopted on account of the short time of delivery.

For the 22,000-volt switchgear, the tender of the B.T.H. Co. was recommended, and for the transformers that of the Westinghouse Co.

Eight new Babcock marine type boilers, each of 40,000 lb. normal steaming capacity, are to be installed; six of the boilers will have Babcock chain-grates and two Taylor underfeed stokers. All the boilers will operate with mechanical draught.

To connect the Riverside and Fearon Road plants, four 0·15 sq. in. 22,000-volt underground cables, of the split-conductor type, will be provided, and the necessary step-down transformers and switchgear at Fearon Road, and, as previously mentioned, at the Tonquin Road sub-station.

The B.I. & Helsby Co.'s tender for 22,000-volt cable was recommended.

The Copper Position.—At the meeting of the Namaqua Copper Co., according to a *Times* report, Mr. T. V. Anthony, a director, stated that the world's production of copper in 1915 was estimated to have been a little in excess of 1,000,000 tons—of which the United States were responsible for some 635,000 tons—and a recent estimate put the present rate of the world's output at 100,000 tons a month. To-day they were face to face with a position for which no parallel could be found in the history of the metal—on the one hand a production far in excess of anything ever hinted at hitherto, and, on the other hand, a price which had not been reached within the memory of any of those present, and, what was still more phenomenal, no visible limit to either. He would, indeed, be a bold man who would venture to predict the point to which prices might yet be taken, in view of the undoubted fact that, huge as the production had become, consumption was keeping pace with it and could hardly be relaxed so long as the war endured—a comforting reflection for producers like themselves, however much it was to be regretted that the result had not been attained by other means.

A ROTARY CONVERTER INSTALLATION.

By E. P. AUSTIN, A.M.I.E.E.

Amongst the various ways of linking up two individual generating systems that employ different periodicities, and are also generating direct current, the following example possesses several interesting features.

A certain generating station supplies energy for public supply and traction, the former being on the three-wire system. The same generators are available for each system, and are used as shunt machines for the lighting supply, and compound for the traction work, two distinct switchboards being used for the purpose.

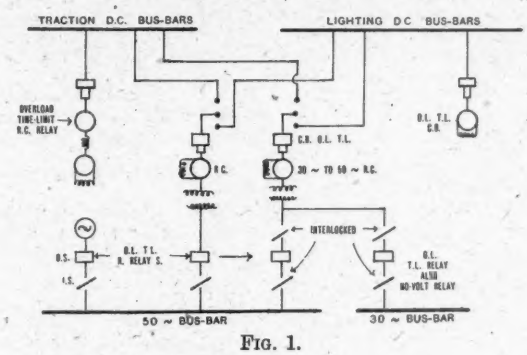


Fig. 1.

A booster rotary converter is installed, capable of running inverted off either D.C. system, and supplying three-phase energy at 50 periods, 6,600 volts, through a step-up transformer. It will also, when required, convert A.C. to D.C. in parallel with either D.C. system.

It became necessary to take a bulk supply from a neighbouring system at 30 cycles, and receive it in such a manner that either D.C. system could be supplied. It was also desirable that the machine installed for the purpose could be run inverted at 30 or 50 cycles off either D.C. bars, and thus form a complete stand-by unit for all conditions of running. The several conditions were met by installing a booster converter capable of running at two different speeds on shunt field adjustment, and giving its rated output at each speed.

A 50-cycle, 6,600-volt alternator has been added to the system to synchronise with the rotaries at 50 periods. This machine is controlled by a voltage regulator acting on the field of the exciter, which is chain-driven off the alternator shaft.

From this description it will be seen that considerable complication has been introduced in order to obtain maximum flexibility. A schematic diagram of the system is shown in fig. 1, and a detailed wiring diagram of the 50-cycle to 30-cycle rotary is given in fig. 2. There are two distinct control panels and cubicles for this machine, all the switches being mechanically interlocked to prevent mistakes in switching and synchronising. Each rotary is fitted with interpoles and is compound-wound, the shunt excitation being obtained normally from the exciter mounted on the rotary shaft. A separate compounded booster is also mounted on the same shaft and connected on the A.C. side, and provided with a potentiometer and rheostat to give a wide range of voltage regulation.

From the diagrams it will be seen that the compound windings of main and booster fields are connected in series, and that it is necessary to change these windings, or short-circuit them as required in accordance with the direction of power supply and the bus-bar to which they are connected. The switching arrangements on the D.C. side provide, therefore, for the following changes :—

Lighting bus-bars, D.C. to A.C. ... Compound machine with compounding reversed.
A.C. to D.C. ... Shunt machine.
Traction bus-bars, D.C. to A.C. ... Compound machine with compounding reversed.
A.C. to D.C. ... Compound machine with equaliser in circuit.

The interpole winding reverses its polarity with the direction of armature current, and therefore requires no switch control.

The rotaries are started up from the D.C. end and synchronised in the usual manner.

The operation of No. 2 rotary is somewhat different. It is usually started from the traction bus-bars as a compound motor, synchronised at 30 cycles, and immediately tripped off the D.C. bars. The compounding is then reversed and the machine is paralleled with the D.C. bars.

The various combinations possible for reliability of supply and efficient running have made the effective protection of all generators a complicated matter, and the relay gear, therefore, deserves a special description. The nature of the load demands short-time overload capacity on the traction and A.C. systems, which sometimes reach 100 per cent. overload for several seconds.

Time-limit overload relays have, therefore, been fitted on all circuit-breakers, and are capable of adjustment on both elements to suit running conditions. As the rotaries can run direct or inverted, the D.C. overload trips are operated off shunts on the main circuit or through change-over switches. On the A.C. side of the rotaries and also on the alternator, inverse time-limit overload relays are used, connected to a D.C. trip circuit, and also three-phase reverse power relays actuate the same tripping element of the oil switches. The latter are necessary to prevent complications when rotaries and alternator are supplying power in parallel, and they will also prevent undue disturbance of the D.C.

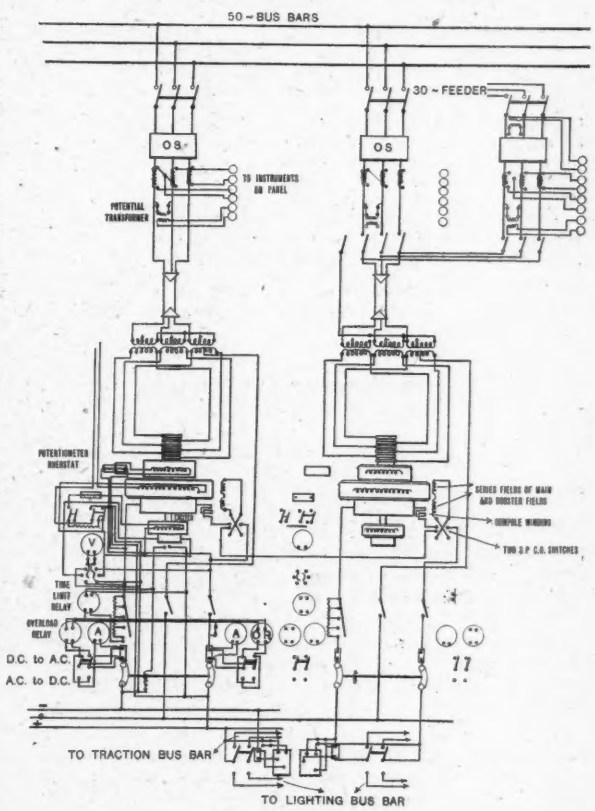


Fig. 2.

supply in the case of bad synchronising. A snap switch is used to cut the reverse power relay out of action when the rotaries run direct.

The protection of No. 2 rotary when taking 30-cycle energy in bulk is still further complicated. Normally, No. 2 runs on the D.C. traction bars in parallel with a steam-driven generator. When the bulk supply temporarily fails, the

rotary A.C. switch must be instantly tripped to prevent the supply from being restored out of phase. A simple no-volt coil is not sufficient, since the rotary will continue running off the D.C. bars and maintain voltage on the A.C. line.

To overcome the difficulty a sensitive D.C. reverse-current relay is used to trip the oil switch immediately energy flows from the D.C. bars. It was also found necessary to install a very sensitive A.C. no-volt relay coil to open the no-volt coil circuit if the supply fails when the rotary is not in parallel with other machines. The situations of all these devices are indicated in the diagram fig. 1, and fig. 3 shows the detail connections of the no-volt protection gear for No. 2 rotary. The general working of this system is quite satisfactory, due in large measure to the careful study of the conditions and the design of the rotary converters to meet them. The A.C. voltage and frequency is maintained very effectively on varying loads. Frequent

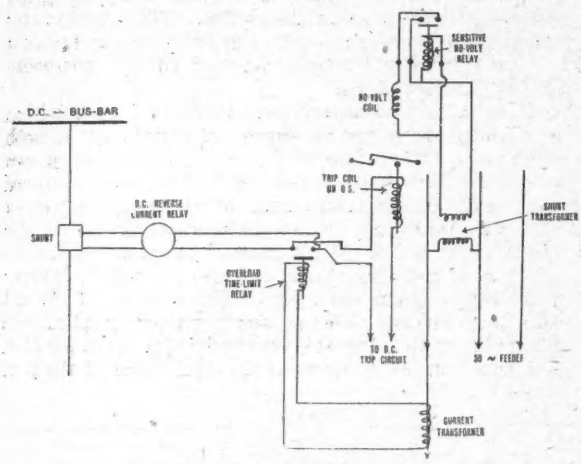


FIG. 3.

adjustment of the compound and interpole windings by means of diverters was necessary, to obtain the best results, in conjunction with the characteristics of the prime generators and engine governors.

Some difficulty was experienced in the parallel running of the rotaries and alternator, owing to the practically flat characteristic of the former combination and the drooping characteristic of the latter. Sudden fluctuations caused uneven divisions of load, and curious divisions of power factor. The use of the previously-mentioned voltage regulator, and the experimentally-determined value of the rotary exciting current, which has been proved to be best at some 20 per cent. lower value than that necessary for running alone, has resulted in very satisfactory operation up to 60 per cent. overload on the combined machines.

BUSINESS NOTES.

Electrochemical Industries in South Africa.—We recently summarised an important report issued by the Development of Resources Committee of the South African Institute of Electrical Engineers, on the possibilities of establishing in South Africa, on a commercial basis, certain electrochemical industries. *The Board of Trade Journal* states that a factory has been established at Vryheid (Natal) for the production of ammonium sulphate. Plant, stated to be capable of producing 5,000 tons annually, has been laid down at a cost of £350,000.

Book Notices.—"*Journal* of the Institution of Electrical Engineers." Vol. 54. No. 259. May 1st, 1916. This issue contains the following papers:—"The Use of Continuous Current for Terminal and Trunk Line Electrification," by Mr. N. W. Storer; "Hire and Maintenance of Continuous Current Motors," by Mr. H. Joseph. Also the Reprot of the Council and the Statement of Accounts for the past year.

"The B.E.A.M.A. Journal." April (Quarterly). 1s. London: The British Electrical and Allied Manufacturers' Association.

Better Times for Working People. By James Glass. London: British Manufacturers' Association' 1916. 16s. 8d. per 100.—This is described as "a straight talk with British working men," and it is written by one who, from birth and experience, is able to understand the position of Labour. The author touches in an interesting way upon many matters. In the main, he tries to show the worker that the Home producer and his work should be protected against the foreign manufacturer and the importer, and that in the councils of the nation business men should have a larger influence. Working men are urged to ask Parliamentary candidates whether they stand for the Protection of British industry, and whether they are in favour of State Insurance of Labour, and to vote against them unless they are sound on these matters. Mr. Glass looks forward to industrial peace and national prosperity being secured, but while we have no desire to throw cold water upon so well-meaning an effort to deal with what threatens to be a somewhat serious situation, we have to recognise that there are still mountainous difficulties in the reformer's path, and that, notwithstanding the war, the defects of our human nature are still very present with us. The pamphlet has been prepared for distribution by employers among their workpeople, and if the latter can be induced to seriously read it, and weigh up its arguments, some good may be done in paving the way for a better understanding between Capital and Labour.

"Post Office Electrical Engineers' Journal." Vol. IX, Part 1. April, 1916. London: H. Alabaster, Gatehouse & Co. Price 1s. net.

"Exporters' Hand-Book and Glossary." By F. M. Dudeney. London: Sir Isaac Pitman & Sons, Ltd. Price 5s. net.

"Mechanical Handling and Storing of Material." By G. F. Zimmer. London: Crosby Lockwood & Co. Price 42s. net.

Bankruptcy Proceedings.—STEEL BROS., 206, East India Dock Road, E.—The first meeting of creditors was held last week at the London Bankruptcy Court, under a receiving order. Mr. Egerton S. Grey, Official Receiver, reported that no one had surrendered under the proceedings. A representative of the petitioning creditor stated that an appearance to their writ was entered by "Sidney Steel, trading as Steel Bros." When the writ was issued the name outside the premises was "The Steel Electrical Engineering Co., Ltd.," but the word "Limited" was subsequently struck out. The same heading appeared on the note paper of the firm. The chairman added that from inquiries made by his inspector, it appeared that the debtor, Sidney Steel, joined the Army in November last, and that a cousin of his had stated that the business now belonged to the company. The case was left with the Official Receiver to be wound up in bankruptcy.

J. W. & T. W. TATTERSALL, electrical engineers, London.—Second and final dividend of 1¼d. in the £, payable at Carey Street, W.C.

Russia.—The French Commercial Attaché in Russia calls attention to the importance of certificates of origin for French and other imports into Russia. This document should bear the *visa* of the Russian Consul in the circumscription where the certification has been made, for this *visa*, which is the simple legalisation of the signature of the Chamber of Commerce which issues the certificate, is absolutely needful to avoid claims by the Russian Customs for dues 100 per cent. increased, notwithstanding the production of a certificate of French origin. French merchants and manufacturers, says the Attaché, do not appear to attach that importance to this *visa* which it really possesses. In short, to have full effect abroad, the certificate should bear the *visa* of the country whither the goods are destined.

Traders' Demands.—At the National Chamber of Trade Conference, on Monday, at Cardiff, resolutions were passed calling for improved technical and business education, for the declaration of a Government policy of trade with enemy countries after the war, and the appointment of a Ministry of Commerce consisting of business men.—*Daily Telegraph.*

A Strike at Pittsburg.—A Central News dispatch from Pittsburg, dated April 26th, says:—"The Westinghouse air-brake plant has been closed down on account of labour trouble. The dispute also involves the Westinghouse electric plant. The total number on strike is 20,000."

Consular Reform?—It is stated in the *Times* that Lord Robert Cecil has informed the Associated Chambers of Commerce that the Foreign Office is prepared to enter into consultation with a Committee of business men in regard to the changes which may be necessary in the Consular Service. Before doing so, however, the Foreign Office find it necessary to discuss the matter with the Board of Trade, but as soon as that preliminary inquiry is concluded the Foreign Office will be happy to receive the views of the Committee of business men and if possible to invite their co-operation.

Patents and Alien Enemies.—Application has been made to the Board of Trade for the avoidance or suspension of patents Nos. 9,499/12, and 13,903/12, issued to Siemens & Halske A.-G., for radiographs and Röntgen-ray tubes, by Messrs. Watson and Sons (Electro-medical), Ltd. Licences have been granted by the Board of Trade to the British Thermit Co., Ltd., in respect of patents Nos. 26,297/04, 21,750/09, 24,389/10, 19,478/11, 16,165/12, 218/13, 1,179/13, and 25,180/13, issued to Th. Goldschmidt A.-G.

The application of Messrs. Bellis & Morcom, Ltd., with respect to Patents Nos. 8,487/06 and 30,101/10, granted to Rogler, for licences has been granted by the Board of Trade.

Catalogues and Lists.—BRITISH INSULATED AND HELSBY CABLES, LTD., Prescot.—Illustrated leaflet, showing their Helsby pattern zinc rods for Leclanché cells.

SIEMENS BROS. & Co., LTD., Woolwich, S.E.—Priced circular respecting "Woolwich" tape of improved type.

ELECTRICAL SUPPLIES Co., 233, Tottenham Court Road, London, W.—Twenty-page price list of electrical accessories. Copies will be sent on application.

Maximum Iron and Steel Prices.—A detailed list of maximum prices fixed, until June 30th, by the Ministry of Munitions, after conference with trade associations, for materials used and produced in the iron and steel industries, is published in the *London Gazette* for May 2nd.

Patent Restoration.—An order has been made restoring Letters Patent No. 10,774, of 1910, granted to Nathaniel Baldwin for "Improvements in sound reproducing devices of the telephone receiver type."

Liquidations.—EXCELSIOR ALUMINIUM SOLDER Co., LTD.—This company is winding up voluntarily, with Mr. J. R. Atkins, 14, St. Ann's Square, Manchester, as liquidator. Meeting of creditors, May 12th.

STOLZ ELECTROPHONE Co. (1913), LTD., London, E.C.—First and final dividend, 7d. in the £, payable at 33, Carey Street, W.C.

Trade Announcements.—MESSRS. J. H. WOOLLISCROFT & Co.—Mr. J. H. Woolliscroft, A.M.I.E.E., who is well-known to many of our readers, and has for some years been general manager of Messrs. H. T. Boothroyd, Ltd., has commenced business for himself under the style given above, at Queen's Buildings, 20, New Quay, Liverpool (telegrams, "Energy" Liverpool; telephone, Central 2341), as manufacturers and suppliers of A.C. and D.C. machinery, switchgear, &c., specialists in repair work, contractors for power plants, factory and ship-lighting installations, &c. Mr. Woolliscroft, who was the inventor of the rotary liquid starter, intends to put on the market the improved patented pattern which we described in our issue of March 3rd; he will be pleased to receive lists and catalogues from supply firms. We wish him all success in his new venture, to which his genial personality will contribute in no small measure.

MESSRS. F. RYMAN & Co., are extending their works at 116, Livery Streeet, Birmingham, and are carrying a larger stock of general electrical accessories. They wish to inform the trade in Glasgow that their agreement entered into in 1912 with Messrs. Paterson & Service for the sale of fuseboards in Glasgow, is not now in force, and orders can be sent direct to Birmingham.

LIGHTING AND POWER NOTES.

Aberdeen.—A report in connection with the supply of electricity to the Caledonian and Great North of Scotland Railways has been submitted to the Electricity Committee, and approved. The report recommends an increase of 20 per cent. on the present charges. It was reported that the output generated in March was 1,423,730 units, an increase of 304,260 units over the same month last year.

Australia.—The Melbourne City Council has decided to establish a depôt for the storage of coal, with a view to placing the electricity undertaking in a more secure position in regard to its coal supply. A site is to be utilised in Arden Street, North Melbourne, to hold 10,000 tons. The capital cost of establishing the depôt, including machinery, is estimated at £8,785, and the annual cost of operation, including interest and depreciation, at £2,342.—*Melbourne Age.*

The Sydney (N.S.W.) City Council has offered to supply the proposed electric steel plant of the Australian Electric Steel Co., at a special rate of ½d. per unit, for not less than 500,000 units per annum, provided the load is restricted to certain hours; a further reduction in price will be made later if the company agrees to increase its load.

The N.S.W. Public Works Department, which proposes to install a generating plant at Port Kembla to supply Wollongong, has offered to extend the line to Bowral, Moss Vale and Mittagong, for pumping and lighting purposes, the local authorities to undertake distribution.

The Inverell (N.S.W.) Municipal electricity works extensions have been formally opened. During the past five years the enterprise has contributed £4,000 to the relief of the rates.

NORTH SYDNEY ELECTRIFICATION.—The Sydney City Council has informed the Council of North Sydney that the delay in supplying electricity to the district was due to the extraordinary conditions affecting the manufacture of electrical apparatus and the transportation of materials. No definite date could be fixed for this supply until the required materials reached Sydney, which would probably be in the course of a few weeks.

A large quantity of lead-covered insulated cable which was to be used for one portion of the North Sydney supply had been delivered in Sydney, but the Federal authorities declared it supplied by an enemy firm, and they had been unable to obtain its release from bond.—*Sydney Evening News.*

The Kilmore (Vic.) Shire Council has decided to take over the undertaking of the Kilmore Electric Supply Co. for £2,500, providing the money can be borrowed at 6½ per cent. The value of the plant has been put at over £3,000. The Council pays £160 per annum for street lighting. The present charge for private lighting is 7d. per unit.

According to *Melbourne Age*, proposals have been made for using the Hobart, Tasmania, hydroelectric power scheme for providing current to operate an electrolytic plant for manufacturing spelter from zinc concentrates. In the event of the negotiations now in progress coming to a head the first unit of a big plant will be erected.

Carlisle.—The County Property Committee has decided in consequence of the saving in the number of lights used and the improved efficiency in the lighting by the partial introduction of electric lighting in the county offices, court houses and committee rooms, to continue the installation throughout the whole of both buildings.

Chelmsford.—E.L. CHARGES.—The T.C. having protested against the minimum charge for E.L. to private consumers introduced by the Electric Supply Corporation, the latter has replied that it sees no reason to alter its decision, the charge being based on a clause introduced into practically every prov. order.

Darwen.—There was a loss of £900 on the working of the Council's electricity undertaking for the past year.

Edinburgh.—There is a considerable deficit in the revenue of the Corporation electric supply department, caused by the lighting restrictions, and the Electric Lighting Committee has decided to increase the rate for current for lighting by ½d. per unit, raising the charge to 3½d.; also to charge 5 per cent. in addition to the present power rate where there is no contract.

Greenock.—PROPOSED LOAN.—The Corporation has decided to apply to the Scottish Office for sanction to borrow £45,000 additional capital. It was stated that the Corporation had been unsuccessful in its endeavour to get the Admiralty to agree to pay any share of the money required.

Halifax.—The Electricity Committee proposes to extend the high-tension mains to Messrs. Goodall's premises, *viâ* Lower Shaw Hill, &c., at an estimated cost of £1,123, subject to certain guarantees.

Haslingden.—During the year ended March last, the total units sold were 892,495, compared with 677,017 units in the previous year, an increase of 215,478 units. The maximum demand was 398 KW. last year, compared with 339 KW. two years ago.

Arrangements have been made for obtaining a supply of electricity from Rawtenstall, and application is to be made to the L.G.B. for sanction to borrow money to cover the cost of the necessary cable and switchgear.

Heston and Isleworth.—The District Council is to apply for sanction to borrow £787, the extra cost of laying feeder cables over and above the sum of £3,569 sanctioned before the war. Sanction has been received to the borrowing of £175 for extending cables.

London.—The B. of T. was to hold a conference on Wednesday to consider the proposal of the Charing Cross Co. to increase for the period of the war its statutory charges for electric current; this proposal, as mentioned in this column, has aroused considerable opposition amongst the company's consumers.

Manchester.—WAGES.—The Workmen Special Committee of the Corporation has considered an application by workmen (other than tradesmen) at Stuart Street generating station, for a special war bonus of 3s. per week. A motion recommending the Electricity Committee to grant the war bonus asked for, was negatived. With regard to another request from another Union on behalf of workmen in the electricity, tramway and other municipal departments that a minimum wage of 30s. per week be instituted without war bonus, in place of the 26s. rate for labourers, the Committee has decided that it cannot see its way to accede to the request.

Nelson.—YEAR'S WORKING.—Mr. G. F. Naylor, the borough electrical engineer, reports that, instead of a small estimated profit on the year's working, there is a deficit of £298.

The Electricity Committee has decided to recommend increases in the price of electricity per unit, of one-eighth of a 1d. in the case of power, and 1d. in the case of lighting.

Nova Scotia.—The proposal to harness the tides of the Bay of Fundy, at Cape Split, Nova Scotia, by means of a current motor, which would pump the water into huge reservoirs on the cliffs above, the descending water furnishing the power, has been followed by a suggestion to utilise the Reversing Falls at St. John, New Brunswick, in a like manner. The suggestion has come from the acting resident engineer of the Public Works Department, who says that a stronger current is available at the Falls than at Cape Split, and that there would be a longer period between tides for a motor pump to operate. All attempts to utilise their tremendous energy have, so far, failed, but by the application of a current motor such as has been suggested at Cape Split, and by the erection of reservoirs on the height above, it is thought that, at last, a way has been found by which the Falls may be harnessed.

Rawtenstall. — Year's Working. — The electricity undertaking has made a surplus during the past year of £1,762, compared with a surplus of £2,005 in the previous year. The result is regarded as satisfactory, having regard to the increased cost of coal (over £1,100), and the increased rates and taxes.

Salford.—During the past month the Electricity Committee has authorised agreements to be entered into for supplying electricity to the premises of the General Electric Co., Ltd., the Broughton Copper Co., Ltd., and Messrs. Richard Haworth & Co., Ltd.

Sevenoaks.—The Electricity Co. has applied to the U.D.C. for permission to use overhead cables in part of the town for the supply of current to consumers.

Stalybridge.—At a meeting of the Joint Tramways and Electricity Board on April 27th, the seal was affixed to the precept on the four Corporations (Stalybridge, Hyde, Mossley and Dukinfield) for the amount of the deficiency in the net revenue for the past year, £7,000, which is to be apportioned in equal shares.

Stoke-on-Trent.—Public Lighting.—The Electricity Supply Committee of the Corporation has decided, owing to restricted lighting, to allow a reduction at the rate of £1,000 per annum on the public lighting account for the current year.

Wimbledon.—The Council has been informed that the Fixed Price Light Co. has paid the amount due in respect of transformer losses in connection with its supply from the Corporation.

TRAMWAY and RAILWAY NOTES.

Australia.—It was recently announced that Messrs. Norton, Griffiths, Ltd., had commenced tunnelling operations in Macquarie Street in connection with the Sydney City Electric Railway scheme.

At a recent meeting of the ratepayers of Port Adelaide it was decided to approve of the Council borrowing £12,000 for electric tramways, as set out in the specifications approved by the Council.

Argentina. — The Government has authorised the Buenos Aires Western Railway to construct in its own workshops, with the assistance of the Great Southern Railway, the coaches required for the company's electric service between the stations of Once and Moreno. The Western Railway had originally contracted for these coaches in Germany, but the war naturally involved the rescission of this contract. British firms were then approached but had to decline the business owing to pressure of war orders.—*Review of the River Plate.*

Belfast.—Year's Working.—The annual report of the general manager of the City tramways, just published, is considered very satisfactory under the present exceptional circumstances. The total revenue for the year ending March 31st, 1916, was £280,641, and the working expenses were £159,800, showing a trading profit of £120,340. After interest and other charges are met, there remains a net profit of £56,735. The sinking fund and depreciation fund absorb £32,434 and £17,000 respectively, £5,000 goes to the general purposes fund for 1915-16, and the balance to the same fund on account of the £15,000 promised for the current financial year. War pay and bonuses amounted to £10,081, and therefore, if it had not been for this special expenditure, it would have been possible to make a large contribution in relief of the rates. For the present year the net revenue is estimated at £69,180, and deducting £52,000 for appropriation charges, a surplus will remain of £17,180.

Bolton.—Wages.—Application has been made for an advance of one halfpenny per hour for motormen, conductors, overhaulers, cleaners and day labourers, and on the standard rate for men working on machines, and the Tramways Committee, while holding the belief that an understanding was arrived at when the last advance was given that there should be no further application before July, 1916, has decided to receive a deputation from the workers' Union.

Certain lengths of track are to be relaid, in accordance with recommendations of the borough engineer.

Bournemouth.—Year's Working.—The report of the working of the Corporation tramways for the past year shows a profit of £14,132, as against £9,083 in the previous year.

British Columbia.—According to the *Electric Railway Journal*, an exceptional record of snowfall was shown during January and February this year, amounting to 76 in. in the city of Victoria and about 60 in. in the city of Vancouver. Despite these severe conditions, the B.C. Electric Railway Co. maintained its city and interurban services on the mainland; in Victoria, however, the service was tied up for two days, due to the breaking of one of the transmission lines under the heavy snowfall. Power was only interrupted for one hour, but the cars were snowed up in that time. It appears that the "jitney" competition shows a great reduction, compared with a year ago, in Vancouver city.

Continental.—Spain.—It is intended to electrify the tramway running from Irun to Fuentarrabia, at present worked by horses.

Sweden.—With a view to electrifying the Eastern and Midland Railway lines of Sweden, the question of utilising the falls at Mjölarp on the Swartan River has been for some time under consideration. The question has been taken up again recently, and guarantees have been given that the station shall be in working order by 1920. The electrification of the Lund-Bjarred Railway is also well advanced, although it has been delayed by the Telegraph Administration owing to arrangements connected with the telephones.

Dublin.—Tramway Stoppage.—In connection with the recent Sinn Fein Rebellion, brief reports to hand show that the tramway system was seriously damaged by the rebels, who obtained possession of the power station, and destroyed portions of the overhead system. It also appears that the electric lighting of the north side of the city has been shut down, owing to damage done, and there has been no gas supply since the commencement of the outbreak.

Haslingden.—Year's Working.—The traffic receipts for the Council's tramway undertaking amounted to £8,105 for the past year, against £7,804 for the year ended March 31st, 1915, with a reduction in mileage of 18,569 and an increase in the number of passengers of 54,692. The average receipts per car-mile were 13·18d., as against 11·30d. for the previous year.

Hull.—Year's Receipts.—The receipts on the Corporation tramways for the year ended March 31st last were £161,945, an increase on the previous year of £195. The total receipts this year to April 22nd were £9,687, a decrease of £1,038 as compared with the corresponding period of 1915.

Manchester.—Through Cars.—Arrangements have been made with the Stockport Corporation Tramway department for the temporary through running of Manchester cars to Reddish in the mornings and evenings to meet the requirements of factory workers employed in the Reddish district.

Nelson.—Year's Working.—The Corporation Light Railways department has made a net profit during the past year of £1,124; the receipts amounted to £10,151, compared with £9,299 in the previous year. The tramway manager reports that the popularity of the discount tickets has been marked. During the coming year it is hoped to add another top-covered car to the rolling stock.

Newcastle-on-Tyne. — Proposed Fare Increase.—The Tramways Committee has been considering the question of increasing the revenue of the City tramways, and has decided to recommend the revision of some of the fares, including the minimum of one halfpenny for soldiers, which is suggested should be raised to one penny. The workmen, it is stated, will have to pay more for their books of coupons.—*Newcastle Journal.*

New Zealand.—The directors of the Takapuna Tramways and Ferry Co. have decided to grant to Mr. P. Hausen an option over the rights to raise the requisite capital for the electrification of the Bayswater-Takapuna tramways.—*Auckland Weekly News.*

Rawtenstall.—Speaking at a meeting of the T.C., Councillor Taylor said that, with the rate-in-aid of £2,000, the tramway undertaking had a surplus of £2,380, the whole of which was to be placed to the credit of the renewals fund. The financial result was very satisfactory, but the amount to the credit of the renewals fund was not sufficient to meet the expected expenditure in the near future.

Rotherham.—Year's Working.—The total receipts from the Corporation tramways during the past year were £52,243, and the total number of passengers carried 11,705,785. There was a gross profit for the year of £19,155, an increase of £4,759 on the previous year.

Salford.—Female Labour.—At this week's meeting of the Council a resolution was to be moved by Ald. Jackson to the effect that the Tramways Committee be instructed to pay all females employed on the cars and in the sheds a war bonus equal to that paid to men performing similar duties.

Sheffield.—Electric Vehicles.—The Midland Railway Co. has placed in service three electric delivery vans of 2 to 3½ tons capacity, for serving the outer areas of the city.

Stalybridge.—Female Drivers.—*Apropos* the recent protests of local Trade Councils against the suggestion that women should be employed as tramway drivers in the district, Councillor Fowden stated at a meeting of the Joint Board, on April 27th, that women should only be employed in the last resort, and that no women should be put to the work without the matter having been brought first before the General Purposes Committee. Ald. R. Wood replied that if the G.P.C. was to take charge of the matter, that should be stated at once, because it was no use the Tramways Committee training women as car drivers if the Board was not going to approve them in the end. There was no idea of dispensing with male labour now or in future, and women drivers would only be employed if male drivers could not be obtained, and then only on safe routes and after thorough training. The discussion dropped.

U.S.A.—The report of the Pennsylvania Railway for the year ended December 31st last mentions that the electrification of the main line suburban zone from Broad Street Station to Paoli was completed, and that multiple-unit electric trains started running on September, 1915.

Pending the obtaining of further experience in the handling by electric traction of heavy freight trains, the proposed electrification of the main line across the Alleghany Mountains between Altoona and Conemaugh, has been deferred.

Walthamstow.—A new formula has been adopted by the District Council for the calculation of the amount to be charged by the electricity undertaking to the light railway undertaking for energy for the year ending March 31st last. In succeeding years monthly payments will be made on the basis of the last annual charge, such payments to be subject to adjustment on the issue of the accountant's certificate after the making up of the annual accounts.

TELEGRAPH and TELEPHONE NOTES.

A U.S. Story.—According to the *Telegraph and Telephone Age*, Mr. Thomas D. Lockwood, general patent attorney of the American Telephone and Telegraph Co., and an old time telegrapher, is responsible for the following anecdote:—

An Irishman who had returned from a visit to the old country was telling a friend of the sights that had impressed him. "The funniest of all," he said, "is the telephone. It's a queer little instrument that you put up to your ear, and one to your mouth, and then you say, 'Are you there?' And the fellow at the other end answers 'Yes' or 'No,' as the case may be."

Cable Censorship.—An agreement has been made between the Danish Merchants' Guild and the British Government, according to which telegrams to America and England concerning business transacted in accordance with the Anglo-Danish Agreement are allowed to pass through the British Censor's Office without delay.

Norway.—A new wireless station is to be erected at Gores'er, with masts 100 m. in height, to communicate with other long-range stations in Europe; it will be constructed on the same scale as that of Nauen, near Berlin, and will be ready for operation next autumn. A contract has just been made with a Berlin company for the execution of the work. A smaller station near it will be provided for communication with ships.—*La Lumière E'ectrique.*

Portsmouth.—An automatic telephone exchange was brought into operation on Saturday last at Portsmouth; it is said to be the largest of its kind in the country.

The Telegraph Service.—The Postmaster-General has issued an important announcement to the effect that, on account of the depletion of the Post Office staff by the withdrawal of men for service with the Colours, the hours of public telegraph business at many post offices have been curtailed. Some of the larger telegraph offices, and a number of the smaller offices, both in town and country, now open at 9 a.m. and close at 7 p.m. for the reception and delivery of telegrams; and senders are warned that telegrams handed in after 6 p.m. may not reach their destination until the following morning.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—May 24th. N.S.W. Government Railways and Tramways. 16 600-volt D.C. motors for tramway stores, Randwick.*

June 20th. Sydney Municipal Council. Supply of a two-ton electric lorry. City Surveyor, Town Hall.

MELBOURNE.—May 31st. Victorian Government Railways. Transformers for five years. First order, 220 transformers in six months.*

June 14th. Victorian Railways. Electric lamps and lampholders for signal system.*

Canada.—May 15th. Ten knots of single-conductor submarine telegraph cable (107 lb. copper, and 150 lb. gutta-percha per knot) with iron wire sheathing, for Canadian Government Telegraph Service Department of Public Works, Ottawa.*

Ingleton (Yorks.).—Electric light installation at St. Mary's Church. Rev. J. Llewellyn, Vicar.

Manchester.—May 10th. Coal slack for 12 months. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall.

May 17th. Electricity Committee. Automatic coal-handling plant at Stuart Street station. See "Official Notices" to-day.

New Zealand.—June 23rd. Oamaru Borough Council. Overhead mains and street-lighting equipment (Contract No. 2); power-station equipment (Pelton wheels, alternators, &c.) (Contract No. 3); service meters (Contract No. 4); line transformers and accessories (Contract No. 5).*

Salford.—May 8th. Electricity Department. High-pressure steel steam pipes and separator, also cast-iron pipes and valves. See "Official Notices" April 21st.

Spain.—May 15th. Municipal authorities of Bellcaire (Province of Gerona). Tenders for the concession for the electric lighting of the town during ten years.

May 18th.—Municipal authorities of Villalbarbe (Province of Valladolid), for the concession for the electric lighting of the town.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Australia.—Sydney City Council has accepted the tender of Messrs. Noyes Bros. for insulated wires and cables, at £7,181, the basis price of copper being taken at £110 per ton.

Bolton.—Electricity Committee. Accepted tenders:—
J. & N. Dickinson, Ltd., construction of a sub-station near Melrose Mill in connection with the supply of current to Lostock Mills.
D.C. motors for 12 months: McClure & Whitfield.

Manchester.—The Tramways Committee has reconsidered the question of the tenders for the supply of electric lamps, referred back at the last meeting of the City Council, and has decided to accept the following tenders:—
Drake & Gorham, Ltd.—Half-watt lamps and drawn-wire filament traction lamps, manufactured by B.T.H. and Edison & Swan.
General Electric Co., Ltd.—Carbon-filament lamps, half-watt lamps, and drawn-wire filament lamps, manufactured by the Osram-Robertson Lamp Works, Ltd.

The Electricity Committee has accepted the following tenders:—
Cable.—Callender's Cable & Construction Co., Ltd.; Pirelli General Cable Works, Ltd.; Chas. Macintosh & Co., Ltd.; Western Electric Co., Ltd.; B.I. & Helsby Cables, Ltd.; Liverpool Electric Cable Co., Ltd.
Crane for sub-station.—Vaughan Crane Co., Ltd.
Low-pressure water and exhaust steam pipes, &c.—Staveley Coal & Iron Co., Ltd.

Salford.—Electricity Committee. Accepted tenders:—
J. Gerrard & Sons, Ltd.—Alterations and additions to buildings and foundations for one 5,000-kw. turbo-alternator, £1,650; extensions to H.T. switch house, &c., £1,060.
British Westinghouse Co., Ltd.—Transformers, £1,088.
Albion Motor Car Co., Ltd.—Four-ton Albion petrol motor-wagon, £896.
Underfeed Stoker Co., Ltd.—Two underfeed mechanical stokers, £1,335, for two water-tube boilers.

Walthamstow.—U.D.C. Recommended tenders:—
W. T. Henley's Telegraph Works Co., Ltd.—Cables during the period ending March, 1917.
P. R. Jackson & Co.—24 commutators, at £5 5s. each.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Friday, May 5th. At 5.30 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Electrical Methods in Surgical Advance," by Sir J. M. Davidson.
Saturdays, May 6th and 13th. At 3 p.m. Tyndall Lectures on "X-rays and Crystals": I, "New Methods of Research"; II, "First Results and their Applications," by Prof. W. H. Bragg, F.R.S.

Royal Society of Arts.—Monday, May 8th. At 4.30 p.m. At John Street, Adelphi, W. Cantor Lecture II, on "Vibrations, Waves, and Resonance," by Mr. J. Erskine-Murray.

Faraday Society.—Tuesday, May 9th. At 8 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W. Ordinary meeting.

Illuminating Engineering Society.—Tuesday, May 9th. At 5 p.m. At the Royal Society of Arts, John Street, Adelphi. Discussion on "A Report to be presented by the Research Committee of the Society." Annual meeting.

Institution of Electrical Engineers.—Thursday, May 11th. At 8 p.m. At Victoria Embankment, W.C. Annual general meeting.
(**Yorkshire Local Section**).—Wednesday, May 10th. At 7 p.m. At the Philosophical Hall, Leeds. Paper on "The Economical Production of Power from Waste Gases," by Mr. G. Dearle.

Chemical Society.—Thursday, May 11th. At 8 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

Physical Society of London.—Friday, May 12th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Papers on "The Latent Heats of Fusion of Metals and the Quantum Theory," by Mr. H. S. Allen; "Lenses for Light Distribution," by Mr. T. Smith; "The Choice of Glass for Cemented Objectives," by Mr. T. Smith.

NOTES.

Bribery Prevention.—A letter has been issued by the secretary of the Bribery and Secret Commissions Prevention League (Inc.), 9, Queen Street Place, London, E.C., appealing for members and associates from the various branches of the engineering profession. The letter reads:—

It is expected, judging by past experience, that when the war is over, and there is eager competition for new business amid the general dislocation of trade, the utmost vigilance will have to be maintained to guard against bribery. Now, and in the near future, there seems to be special need for the work of the League in combating corruption in official, commercial and private life. It is recognised, however, that the demands of the war, directly or indirectly, are such that many persons may be unable to become members of the League at the present time. It has been decided, therefore, as a temporary measure, due to the war, to consider those who give not less than 5s. as associates, for 12 months. Similarly, trade organisations which wish to help the League but lack the funds for affiliation, or shrink from the responsibilities involved, will be grouped as associated organisations, on making an annual payment of one guinea.

The Business Languages of South America.—There are two business languages used in South America: the language of Brazil, with about 20,000,000 people, is Portuguese; the language of the rest of South America, comprehending an equal number of people, is Spanish. Portuguese and Spanish—these are the business languages of South America. The business man must use in his correspondence and through those who represent him the language of the people he wishes to reach.

Under no conditions should a letter addressed to South America be written in English, unless the writer is positive that the person to whom it is addressed reads and speaks English fluently. If the writer does not know that the person he is addressing possesses this qualification, the letter must be in Portuguese if sent to Brazil and in Spanish if sent to any other South American country. On the other hand, it is always safe to answer a letter from South America in the language in which it is written.

The racial traits of courtesy possessed by all South Americans tend to make them lenient of errors in language, provided the attempt to make oneself understood is genuine. Thus, a letter written in poor Portuguese or poor Spanish is far better than one written in good English. The English letter would probably reach the waste basket without an attempt being made to read it. On the other hand, the letter in understandable, though inelegant, Portuguese or Spanish would be read and its contents grasped.

All business letters written by South Americans are most courteous in style. They are cordial and even gracious. To us, both the salutation and the closing greetings are effusive. Scattered through the body of the letter are frequent phrases of direct address to the one who is to receive the letter, worded in the most polite terms. When reading such expressions, one can almost imagine the courtly raising of the hat that accompanies the meeting and parting of business men in South America.

Three examples of common salutations in Spanish business letters are herewith given, each being followed by a rather literal translation into English: *Muy Senor mió*—My dear Sir; *Distinguido Senor*—Distinguished Sir; *Illustrissimo Senor*—Most Illustrious Sir. Three endings for letters, similarly translated, are also given: *Quedo de Vd. atto. y S. S.*—I remain to your Grace your attentive and obedient servant; *Me repito de Vd. atto. y S. S.*—I repeat to your Grace that I am your attentive and obedient servant; *Esperando sus órdenes S. S.*—Awaiting your orders, I am your obedient servant.

From these few phrases it is easily imagined how offensive our brusque North American style of letter writing must be to anyone who naturally, and by association and training, uses most courteous forms in addressing others.

The importance of using the language of the country in dealing with South America has been realised and acted upon by both the British and the Germans. The German has acted from his usual disposition to take advantage of everything that might count; the Englishman has accommodated himself to necessity. The final result is that the salesmen representing German and British houses are well equipped with a knowledge of the language of the countries with which they are doing business, the customs of the people, and the niceties and refinements of business intercourse. These qualifications give them a decided advantage over North Americans who have failed to appreciate and learn these important things. In the case of the British, however, it must be confessed that this acquirement is a veneer, for when Englishman meets Englishman, or Englishman meets American, the brusque Anglo-Saxon ways again come to the surface.

This subject of business languages in South America is so important that everyone who is exporting to that continent should see to it that only Portuguese and Spanish are used, and that the courteous forms of expression which enter into the daily business intercourse of the peoples of those countries are scrupulously observed.—*American Machinist.*

Electric Winding in South Africa.—In a paper read by Mr. J. Norman Bulkley, before the American Institute of Mining Engineers, on the application of electric power to mining work in the Witwatersrand area, some particulars are given of electric winding plants in South Africa. The area contains 143 electrically-driven hoisting engines, exclusive of winches. The combined continuous rating of these hoists amounts to 74,000 H.P., or an average of 517 H.P. Although exact comparisons of costs with steam winding plants are not possible, investigation favours the use of electric winding, especially in deep shafts. One result is a marked decrease in the cost of maintenance of shaft guides, owing to the steadier turning moment of the electric winder, while greater safety and reliability are also found with the electric hoist.

A comparison of the efficiency of two winding plants operating under similar conditions, but one equipped with a geared three-phase rheostatic winder, and the other with a Ward-Leonard winder, shows that where the latter has been kept working steadily, its efficiency exceeds that of the rheostatic set by about 5 per cent., but where the shaft H.P.-hours have dropped, the efficiency of the Ward-Leonard set has dropped with them, showing the bad effect of intermittent winding due to the practically constant losses of the motor-generator set, while with rheostatic control the only loss, when the hoist is standing, is that due to the controller pump motor, which is negligible.

In the case of a mine under Mr. Bulkley's charge, a complete change from steam to electric drive was made, and, at the same time, the milling capacity was increased from 15,000 to 17,000 tons a month, and the air-compressor plant by one-third.

A comparison of the last two years of steam operation and first year of electric service showed a saving in favour of electric drive of $12,000 per annum, without making any allowance for the increased capacity of the plant.

American Electrical Exports in January.—The electrical exports for January were surpassed in recent months only by the record shipments in November. In the four electrical classes for which the numbers of articles exported are given in the Government Report, there were shipped in January the following:—Electric fans, 1,433; arc lamps, 154; carbon-filament lamps, 128,522; metal-filament lamps, 507,527. The detailed figures for last January and for the corresponding month in 1915 are given below:—

	Jan., 1916.	Jan., 1915.
Batteries	$115,354	$100,946
Dynamos or generators	56,983	309,868
Fans	16,010	17,221
Insulated wire and cable... ...	265,622	83,728
Interior wiring supplies, &c. (including fixtures)	87,611	72 104
Arc lamps	1,203	759
Carbon-filament lamps	14,667	5,802
Metal-filament lamps	109,720	38,504
Meters and other measuring instruments	75,352	40,556
Motors	389,380	205,140
Telegraph instruments (including wireless apparatus)	5,802	17,326
Telephones	69,050	184,556
Transformers	55,708	57,122
All other	1,058,360	640,306
Total	$2,320,822	$1,773,938

Electric locomotives are separately listed in the report. In January eight of these, valued at $151,245, were exported.—*American Electrical Review.*

Society for Electrical Development, U.S.A.—To effect closer co-operation between the Jovian Order and the Society for Electrical Development, reigning Jupiter Thomas A. Wynne has appointed James M. Wakeman, General Manager, Harry W. Alexander, Director of Publicity, and George W. Hill, of the Field Co-operation staff, as Statesmen-at-Large in the Jovian Order. The Jovian Order, with its nearly 20,000 members, has substantially the same object as the Society for Electrical Development, but its functions are different. The recent appointments will effect better co-operation which will consistently complement the work of both organisations, such as the founding and fostering of local Jovian Leagues, and the harmonising of relations between local electrical interests. During the "America's Electrical Week" campaign next autumn, it is expected that the Jovians will exert great force in the handling of local sales, committee work, and celebrations. The Society will, however, conduct the national campaign as it did the Electrical Prosperity Week.

Electrical Rain-making in Australia.—Upon the recommendation of the committee of investigation into Mr. Balsillie's proposals for rain-making, the Premier of New South Wales is communicating with Dr. G. C. Simpson, of Simla, India, and also with Prof. Bragg, through the Agent-General. Dr. Simpson has been selected on the ground that he has carried out the most recent and the most comprehensive investigations into the scientific principles involved in water precipitation from vapour, which have come under the notice of the Committee. One or two English scientific men at times have investigated the subject to some extent in its relation to rain-making; and Prof. Bragg, who is in a position to get reliable advice at once, will be invited to assist the Committee. The Premier has altered the title of the Committee, on its own recommendation, to the "Rain Precipitation Investigation Committee."

Cheap Power.—In a letter to *Met. and Chem. Engineering*, Mr. W. E. Herring, of the Puget Sound Traction, Light and Power Co., Seattle, states that his company has water-power plant of 74,000 H.P., supplemented by steam plant of 34,000 H.P., and the regular commercial power rate for loads above 101 H.P. for continuous use is ½d. per KW.-hour. Still lower terms are offered to concerns that use large powers continuously, and the company is about to develop from 75,000 to 150,000 additional H.P.

Daylight Saving.—It is reported that the Government will probably accept a motion put forward by Sir Henry Norman, on the lines advocated by the late Mr. W. Willett, to advance the public clocktime by one hour during the summer months, with a view to effecting economy in the use of fuel. The French Chamber of Deputies has already passed a Bill giving the Government power "until the end of the year when the treaty of peace is signed" to vary the legal time; whether the Senate will agree to it remains to be seen. It is estimated by the supporters of the Bill in France that a saving of two millions sterling will result. Similar measures have been adopted by Germany, Austria, and Holland as from May 1st.

American Reconstruction Work in Belgium.—We read in the *American Electrical Review* that Mr. Nevil Monroe Hopkins, as chairman of the Belgian Scholarship Committee, Washington, is making an appeal to the professional and scientific men of the United States for assistance in providing a fund for the reconstruction of Belgian educational facilities and opportunities for development in arts and science. The Committee includes among its members the Presidents or Chancellors of the following Universities:—Johns Hopkins, Princeton, Michigan, Missouri, Leland Stanford, Pennsylvania, George Washington, State of New York, Nebraska, Rice Institute, Western Reserve, and many other leading men of the country. It is proposed to establish a fellow-

ship upon the basis of $1,000 a year for the duration of the war and two years thereafter, a sustaining membership of $100 and an associate membership of $10 each year under the same circumstances.

Volunteer Notes.—ENGINEERING INSTITUTIONS' V.E.C.—Orders for week commencing May 8th, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25.

Monday, May 8th.—Sections 1 and 2, Technical; Sections 3 and 4, Squad and Platoon, Signalling Class and Recruits.

Tuesday, May 9th.—School of Arms, 6 to 7 p.m.; Recruits' Drill, 7.15 to 8.15 p.m.

Thursday, May 11th.—Shooting for Sections 3 and 4; Recruits, 5.45 to 7.45 p.m.

Friday, May 12th.—Sections 3 and 4, Technical; Sections 1 and 2, Squad and Platoon; Signalling Class and Recruits.

Saturday, May 13th.—Adjutant's Instruction Class at 2.30 p.m.

E. G. FLEMING,
Company Commander and Acting Adjutant.

3RD BATT. (OLD BOYS) CENTRAL LONDON VOLUNTEER REGIMENT.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, May 4th, 1916:—

Week-End Parades.—Saturday.—The Battalion will Parade at Baker Street Station, at 2.30 p.m., and proceed by train to Wembley Park for Battalion Drill, under the Adjutant.

Sunday.—The Battalion will Parade at Victoria Station, Wilton Road entrance at 10.20 a.m., and proceed by train to Orpington, for Field Operations with the 3rd Batt. West Kent Volunteer Fencibles. The Battalion will leave Orpington on the return journey at 5.12, reaching Town at 6.4 p.m.

Musketry.—Inter-Battalion Cup Competition. There will be practice at Bisley for above Competition on Saturday, May 6th. The range will also be open to other members. Names to be sent in to the Musketry Staff by Friday midday. Members to report themselves, in Uniform, at 12.45 p.m., to Sergeant Cotter, No. 6 Platform, Waterloo Station.

A. G. JOINER, *Major and Adjutant*, O.B.C.

Appointments Vacant.—Junior engineers-in-charge (45s.), for the Borough of Newport (Mon.) electricity department; assistant engineer (£150); jointer (£2), for the Borough of Gillingham (Kent) electric light and power department. See advertisement pages to-day.

Institution and Lecture Notes.—University of London, University College.—The following, among other, public lectures are announced:—Tuesday, May 9th, at 5 p.m.—"The School of Chemistry at University College: Turner, Graham, Williamson, Ramsay," by Prof. J. Norman Collie, F.R.S. Monday, May 15th, at 5.30 p.m.—"The Manufacture of Nitrates from Air by Electric Power," by E. Kilburn Scott, M.I.E.E. Tuesday, May 16th, at 5 p.m.—"The Rôle of Chemical Science in Civilisation," by Prof. F. G. Donnan, F.R.S.

Institution of Electrical Engineers.—The annual general meeting of the contributors to the Benevolent Fund will be held at the Institution on Thursday, May 11th, at 9 p.m., to receive the report of the Committee of Management and the statement of accounts and balance-sheet to December 31st, 1915. At this meeting the names of the Committee of Management for 1916-17 will be declared. A general meeting of the contributors to the Fund will be held as soon as the business of the annual general meeting is concluded, for the purpose of considering alterations to Rules 9 and 10 of the Fund.

Society of Engineers (Inc.).—On Monday a conference of engineers, convened by the Society, was held to discuss the subject of "Engineering and Scientific Research." Dr. J. A. Fleming, F.R.S., who opened the discussion, showed that there were three main divisions of such researches:—

1. Those bearing on the determination of physical constants or specific qualities of materials required as an aid to design.
2. Researches which provide new methods of testing materials or structures.
3. Researches which involve new appliances or processes of manufacture.

He said that there were no cut-and-dried methods by which we could engender originality, but it was of the utmost importance to foster it in anyone who gave evidence of its possession. A totally changed attitude in the public mind towards scientific research was required. Until we produced more men who could do new things, and not merely know about old ones, it was futile for Great Britain to hope to gain pre-eminence over Germany in scientific industries. The advantages which we had in greater originality of mind and better workmanship were neutralised to a large extent by the want of a sufficiently thorough and broad scientific education to enable us to see the practical value of, and work out exhaustively, especially with reference to trade purposes, the openings given by scientific discoveries. Our post-war policy could not be simply defensive. No tariff wall could be built so high, no boycott of German goods could be so thorough, as to defend our position in the absence of a positive and vigorous policy of attack.

Rontgen Society.—It is proposed to conclude the Session in June with an exhibition of apparatus employed in radiography, radiotherapy including radium technique, electromedical appliances, and photographic apparatus to illustrate technique as applied to medical science.

Royal Institution.—At the annual meeting of members held on Monday afternoon the report of the Davy Faraday Research Laboratory Committee was read. Fifteen new members were elected in 1915. Sixty-two lectures and 19 evening discourses were delivered in 1915. The following officers were elected for the ensuing year:—President, the Duke of Northumberland; treasurer, Sir James Crichton-Browne; secretary, Col. Edmond H. Hills; managers, Sir Thomas Barlow, Bart., Sir W. P. Beale, Bart., Dr. H. T. Brown, Sir J. Mackenzie Davidson, Lord Grenfell, Charles Hawksley, Col. Sir F. Nathan, the Hon. R. C. Parsons, Sir J. Reid, Bart., Sir Napier Shaw, Alexander Siemens, Dr. S. P. Thompson, Lord Wrenbury, Sir A. F. Yarrow, Bart., Sir Robert Younger. Visitors, H. Ballantyne, S. G. Brown, J. F. W. Deacon, W. Duddell, Lieut.-Col. H. E. Ganlter, Dr. J. Dundas Grant, J. W. Jarvis, H. R. Kempe, F. Legge, E. R. Moon, H. G. Plimmer, Sir W. Wyndham Portal, Bart., A. W. Porter, H. Munro Ross, Joseph Shaw.

Institution of Civil Engineers.—The Council has awarded a George Stephenson Gold Medal to Mr. F. W. Carter, M.A. (Rugby), for his paper on "Electric Locomotives."

West Ham Municipal Technical Institute.—A special course of seven lectures on "Some Industrial Applications of Electricity," with practical work, will be given in the Institute, Romford Road, West Ham, on Monday evenings, from 7 to 9 p.m., commencing May 15th. Fee for the course, 2s. 6d. Particulars are given in our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The following members of the staff of the Leicester electricity department have received advances in salaries:—Mr. W. E. BARTON, superintendent of the Aylestone station, from £300 to £325 per annum; Mr. G. MORRIS, car-shed superintendent, from £260 to £285; Mr. E. J. RILEY, chief clerk, from £200 to £215; Mr. H. E. ROGERS, mains superintendent, from £190 to £225; and Mr. G. E. PURDY, draughtsman, from 40s. 6d. to 50s. per week.

General.—Mr. WARE, Accrington Fire Brigade and lighting superintendent, is to have his salary increased from £160 to £200 per annum, and is to take charge in future of the whole of the public electric lighting of the town, and not, as at present, of the Blackburn Road section only.

Mr. P. J. PRINGLE, M.I.E.E., M.I.M.E., has been appointed consulting engineer and assessor to the Melbourne Tramway Board, recently formed, and will act in connection with the transfer of the Melbourne Tramway & Omnibus Co.'s undertaking to the Tramway Board. Mr. Pringle is general manager and chief engineer of the Electric Supply Co., of Victoria, Ltd., and will continue to discharge these duties.

Mr. LEONARD FREDK. ALLDAY, who was married at St. Clement's Church, Boscombe, on April 24th, to Miss I. H. Sanbrook, was presented by his colleagues in the electrical department of Devonport Dockyard with an oak-cased chiming clock.

Official notice from the *London Gazette*.—Territorial Force. Royal Engineers, London Electrical Engineers, Temporary Second-Lieutenant T. S. WALLIS, from R.E., to be Second-Lieutenant.

Mr. C. F. BUTLER, A.M.I.E.E., late acting manager and engineer of the Gravesend and Northfleet Tramways, has taken up an appointment under the War Office as station engineer to the group of electric generating stations at Fovant, Salisbury.

Roll of Honour.—Sergeant NORMAN GREEN, of the Durham Light Infantry, who has died in hospital at Boulogne of wounds received in action, was, prior to the war, engaged with Messrs. W. E. Dove & Co., Ltd., electrical engineers, of Darlington.

Obituary.—MR. FREDERICK WALKER.—The death of Mr. Frederick Walker, at Cheltenham, at the comparatively early age of 62, will recall to many of those with whom he was associated in the early eighties, and since, a personality almost unique in the engineering and electrical world. In his profession he was a genius, and on the subject of aerostatics his judgment and versatility were pronounced. In the book published by him in 1910, *Aerial Navigation*, his remarks, read in the light of recent events, may be considered almost prophetic. In the preface to his last book, Mr. Walker said:—

> The advent of the aeroplane as a medium for sport has commenced a new era of trade, and the exigencies of the preparations of foreign Powers for aerial war apparatus needs must stimulate our own Government to action in the same direction.
>
> But whatever is done, in the matter of aerial navigation in the way of trade and inventive genius, should be done by the British people themselves; I cannot believe that the race has deteriorated to such a degree that we should depend upon foreign invention and manufacture for what we need at home. There is no need, for ages to come, to fear a social revolution or the destruction of civilisation by the advance of aerial navigation. This could only be effected by the discovery and application of the neutralisation and regulation of the force of gravity. Given this as a secret under the control of a peaceful and highly-civilised Power, and war and its concomitant horrors would be a story of the past.

Another extract from this book goes on to say:—

There is a great future before the aeroplane, and also before the airship, which is built as a rigid combination between the aerostat and the aeroplane. It is certain that with such an airship, having controllable vertical movement, with fuel and provision for eight men for one month, no spot upon our planet may remain unexplored and uncharted.

It must be conceded, however, by the most pacific of teachers, that it is well for every nation to prepare for defence, and, without going so far as to entertain or encourage a possible "war in the air," a fleet of properly constructed airships is a necessary adjunct to a navy, more especially for that of a nation like Great Britain, with an insular centre, so dependent upon the command of the elements surrounding it.

Born at Charlton, Kent, in 1853, he served an early apprenticeship of seven years as a millwright. His workshop training at Bryan, Donkins, Easton & Anderson's, &c., and a ripened world-wide experience gained as a sea-going engineer in the P. & O. service, peculiarly fitted him in later years for the profession of a consulting engineer and patent agent. He was employed, among other things, in first installing the electric light on the Suez Canal, the designing of the *Volta* (the first electric launch to cross the Channel) in conjunction with the late Anthony Reckenzaun, and was the patentee of the first dry battery in 1881, and closely identified with the "Jarman" electric road cars in 1880. He was also associated with the early beginnings of many well-known engineering and allied firms, and in particular with the late Gustav Binswanger in the inception of the G.E.C. Mr. Walker was a well-known contributor to the technical Press, and author of many works, including *Practical Dynamo Building, Tables and Memoranda for Electrical Engineers, Electricity in the Engine Room, Design and Equipment of Launches*, &c. In his later days Mr. Walker for many years practised the profession of a consulting engineer and patent agent, until, through failing health, he retired into the country, near Cheltenham, where he was much sought after by those who valued his mature knowledge, gained by his practical experience and naturally scientific mind.

Wills.—The late Lady KELVIN left £5,000, to be applied for promoting research and the teaching of physical science in connection with a natural philosophy chair, and all the decorations and medals conferred upon Lord Kelvin, to Glasgow University.

The late Sir C. RIVERS WILSON left unsettled estate £10,091 and net personalty £8,528.

REVIEWS.

Atmospheric Circulation and Radiation. By F. H. BIGELOW, M.A. London: Chapman & Hall. Price 21s. net.

This is a meteorological treatise on the circulation and radiation in the atmospheres of the earth and of the sun, by a member of the Argentine Meteorological Office, who was for many years Professor of Meteorology in the U.S. Weather Bureau, and, therefore, is exceptionally well equipped for the task which he has set himself of adjusting the thermodynamic equations employed in meteorology to a uniform basis in accordance with the non-adiabatic system prevailing in the atmospheres above-named. Obviously this is not the place to discuss the author's work at length; we are mainly concerned with those chapters in which he deals with the electrical and magnetic phenomena connected with the atmosphere. Numerous references to authorities are given, and the author does not go into particulars with regard to instruments and methods of measurement, but briefly states the formulæ employed, with their significations and some examples of their applications. The cause of the wide discrepancy between the values obtained by different methods for the conductivity of the atmosphere is discussed, with the aid of numerous observations, and the difference is ascribed to a difference in the conditions of experiment; it is stated that the absolute values of the dissipation coefficients must be obtained by ion-counters, the Elster and Geitel apparatus being suitable for giving relative, but not absolute, values. The characteristics of the atmospheric electric potential are ascribed to ionisation of aqueous vapour by the incoming radiation, producing a normal charge of 150,000 volts at a height of 5,000 metres. A chapter is devoted to terrestrial and solar relations, in connection with the diurnal phenomena, especially the variations of the electrical and magnetic elements; these are influenced by the convective movements of the atmosphere, and react upon one another also. The author remarks that the evidence is very strong that the magnetic variations depend upon ionisation in the lower strata, and not upon any system of ionisation currents in the upper strata. The aperiodic variations are also studied, and the author infers that there is a marked tendency to correspondence with the rotation of the sun in 26.68 days; there is also a semi-annual change in the phenomena, and the author remarks that the problem of the solar radiation and its effects throughout the earth's atmosphere is an exceedingly complex phenomenon. He is not without hope that the development of meteorology and solar physics will eventually enable us to predict the seasonal climatic conditions likely to prevail during the coming year in the great agricultural regions of the earth. While his work is mainly of use as a reference book, it is highly original in character and aim, and should be found of great value to meteorologists.

Handbook of Instruction for Wireless Telegraphists. By J. C. HAWKHEAD and H. M. DOWSETT. London: The Wireless Press, Ltd. Price 3s. 6d.

This is a second edition of Mr. Hawkhead's book, which has been taken in hand by Mr. Dowsett for revision and enlargement. A very marked improvement in the appearance, quality, and illustrations has been effected. With the exception of amplification in a number of places, and a much more complete description of the Marconi portable sets, the text remains of the same general standard. In Part II, covering the theory of waves, the faulty illustrations have been replaced and considerable revision has been effected in the text. Of the two or three additional illustrations, one gives an original conception of the shape of electric strain lines as they are stated to exist in the waves thrown off by an antenna. The object of this departure from the Hertz diagrams is not clear, and it is hardly a success. The sharply-pointed waves shown do not, of course, exist in reality.

While the information given is generally sound, it is hardly of the standard suited to high-class instruction, but will undoubtedly be valuable to operators using the Marconi apparatus. The latter appears to be the object of the work.

Examples in Alternating Currents. Vol. I. By Prof. F. E. AUSTIN. From the Author, 11, South Park, Hanover, N.H., U.S.A. Price $2.40 (in America).

The first thing which strikes one about this book is that it is printed in green ink. Possibly some readers may like this; personally, we do not like it, and we find that it makes indices, subscripts, and small lettering on figures difficult to decipher. The next thing to strike one is the high price, but the cost of setting up mathematical matter is notoriously high, and the setting is done well in this instance, so we are prepared to forgive the rather high price, especially as the author is honest enough to say in his opening sentence that "one object of the book is to make money"! So many authors pretend to be philanthropists.

These initial prejudices vanish rapidly on a closer examination of the work, the scope of which is, perhaps, best explained to British engineers and students by saying that it gives a "pocket-book treatment" of alternating-current problems, the electrical principles involved by the latter, and the mathematical methods required for their solution. The treatment is sufficiently detailed to make the book readable and of value to students, as well as a work of reference for those wishing to refresh their memories on a particular point. Though there is, naturally, no particular "plot" in the book, its sections are arranged so that a student could start at the beginning and follow it right through intelligently. Previous knowledge of fundamental electrical matters and mathematical methods is, however, necessary unless the book is to be used as a class manual and supplemented by oral explanation. In this connection it should be particularly valuable.

The preliminary sections include a well-arranged collection of trigonometric formulæ, geometrical relationships, and clear rules for differentiation and integration. Good definitions of A.C. quantities are given, and there is a good treatment of the fundamental formulæ bearing on the generation of E.M.F. and of the constants and properties of sine curves. Instructive examples are given and supplemented by sufficient hints to make them really useful. A good deal of space is devoted to methods of determining the area under various curves, particularly as applied to A.C. problems, to addition and multiplication of sine forms, and so on. The student should be enabled by these pages to deal confidently with any problem concerned with wave form.

Inductance in straight conductors and in coils, impedances in series and in parallel, pure capacity, the properties of various arrangements of condensers, and the characteristics of A.C. circuits containing various mixtures of resistance, inductance, and capacity are all dealt with very clearly, frequent use being made of vector diagrams to supplement analytical results and methods. The author adopts different types of arrow heads to distinguish between pressure, current, admittance, and impedance; this device is successful where the vector diagrams are reasonably large. A series of tables at the end of the book gives values of $2\pi f$, for frequencies from 1 to 151 cycles, and corresponding values of $1/(2\pi f)$, $(2\pi f)^2$, and $1/(2\pi f)^2$. Here are also tables showing the capacities in farads necessary to neutralise inductance from 0.1 to 0.99 henry, and from 1 to 25 henries, and produce resonance at frequencies of 15, 25, 60, and 100 cycles. These and other special tables form a valuable feature, and it is a pity they are blemished by as many as 10 or 11 figures being given without any spaces to facilitate transcriptions.

The illustrations in the book are good, save that the lettering is generally much too small and is, consequently, illegible in some cases. On the other hand, there is an excellent index, and the arrangement of the text and mathematical matter is exceptionally clear. All the resources of the printer have been called upon to discriminate between main essentials and amplifications and examples. Revision seems to have been done very carefully, and we notice no misprints, though we cannot claim to have checked every calculation. One soon grows accustomed to the green ink, and the book is one which must be more appreciated the longer one has it in use. It should circulate freely amongst students, teachers, and practising engineers.

Directions for Designing, Making, and Operating High-pressure Transformers. By Prof. F. E. Austin. From the Author, 11, South Park, Hanover, N.H., U.S.A. Price 60 cents (in America).

This book gives quite a good treatment of the fundamental principles of transformer action and construction. The figures given after the introductory section are intended primarily to assist those who wish to build a step-up transformer, but the data are useful in helping those who study the subject without going in for practical work, to a better understanding of the principles of transformer design and operation. Transformer losses are dealt with at some length, data being given to enable the reader to calculate the losses in any particular case. Sections are devoted to power factor and transformation ratio, and the author then works through the chief steps in designing a 1-kw. transformer operating at 110/20,000 volts on 60-cycle supply; this is done fully so far as concerns the losses, weights of material, iron and copper sections, &c. Directions and data are then given for building a 3-kw., 110/20,000-volt, 60-cycle transformer; the instructions are so complete that the reader should have no difficulty in building any other small transformer of the same order of magnitude, and for about the same working pressures. The cost of materials for the transformer described is about £6 10s. A short section is devoted to oil-immersed transformers, and attention is, very properly, drawn to the precautions to be observed in working with step-up transformers. The author's statement that the transformer he describes will pass "enough (current) to kill a person several times," contains a little unintentional humour, but the warning is none the less convincing.

In the concluding sections of the book there are data relating to a 4,000-volt transformer, a discussion of the use of transformers as frequency changers, notes on obtaining unity power factor by the use of condensers, and notes on connecting primary coils to produce different secondary pressures. The book is interesting and instructive.

The Practical Design of Steel-framed Sheds. By Albert Spencer. London: Constable & Co., Ltd. Price 10s. 6d. net.

The war has caused the springing up of an unprecedented demand for steel-framed sheds, such structures being needed all over the country in connection with the production of munitions. According to Mr. Spencer's calculations, it would seem likely that in many cases such sheds are unskilfully designed. In fact, his complaint is that owing to the designing of sheds being left almost entirely to the manufacturers of such structures, who are often working on a severely competitive basis, many designs are open to serious objection on the score of capability to withstand all stresses with a good factor of safety. The trouble, the author is convinced, lies mainly in the fact that in most treatises on this subject, and also in the instruction provided at our technical colleges, too much attention is devoted to the design of the various units without proper regard to the structure as a whole. He, therefore, presents, in a clear and coherent manner, methods which, if adopted, should greatly facilitate the practical design of trustworthy shed framework and foundations. An intimate knowledge of the theory of structures and of practical designing is assumed to be already in the possession of the reader, and, given this, a student on the subject should find much food for thought in Mr. Spencer's calculations.—G. S. S.

NEW COMPANIES REGISTERED.

Harlesden Lamp Co., Ltd. (143,701).—This company was registered on April 26th, with a share capital of £10,000 in 9,800 pref. shares of £1 each and 4,000 ord. shares of 1s. each, to acquire and turn to account any invention relating to electric and other lamps, or any lenses, reflectors, or other component parts or accessories for use in connection therewith, to carry on the business of manufacturers and repairers of, and dealers in, electric lamps, reflectors, lenses, or other articles, electricians, opticians, glass-blowers, &c., and to adopt an agreement with C. B. Leake. The subscribers (with one pref. share each) are: C. B. Leake, Red House, Harefield, Middlesex, gentleman; J. M. Longe, St. Margaret's, Hallowell Road, Northwood, Middlesex, gentleman. Private company. The number of directors is not to be less than two or more than five; the first are C. B. Leake and J. M. Longe. Qualification (except first directors), 500 shares. Remuneration, £200 per annum, divisible. Solicitor: W. E. Craigen, Cromwell House, Fulwood Place, Holborn, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

W. E. Dove & Co., Ltd. (72,630).—Capital, £3,500 in £10 shares. Return dated March 13th, 1916. 320 shares taken up; £2,000 paid; £1,200 considered as paid. Mortgages and charges: £1,100.

Carville Site & Power Co., Ltd.—Issue on April 20th, 1916, of £10,000 debs., part of a series of which particulars have already been filed.

CITY NOTES.

German Electrical Companies.

The Deutsch-Atlantische Telegraphen Gesellschaft proposes to pay a dividend of 6 per cent. for 1915, as contrasted with 6½ per cent. in the previous year.

The Osteuropaische Telegraphen Gesellschaft, of Cologne, which owns the cable between Constantza and Constantinople, records net profits of £15,600 for 1915, as contrasted with £12,300 in the preceding year, when a dividend of 7 per cent. was paid on the share capital of £50,000. The method of disposing of the profits available for 1915 is not disclosed.

The report for 1915 of the *Welter Elektrizitats und Heberzeug Werke, of Cologne,* states that activity became greater and more uniform on the completion of the changes in working for the execution of Army contracts, and the company was also well occupied on the construction of lifting plant. The net profits of £3,300 permit of the payment of a dividend of 5 per cent., this result contrasting with a loss in the previous year.

The report of *Gebr. Korting A.G., of Linden,* states that the company was able to deal with the increasing requirements for electrical machinery in 1915. No information was forthcoming in regard to the subsidiary companies in enemy countries, but the turnover in Austria-Hungary expanded considerably. The gross profits advanced from £147,000 in 1914 to £253,000 last year, and the net profits from £37,000 to £112,000 in the two years respectively. It is intended to pay a dividend of 10 per cent. on ordinary share capital of £950,000, as compared with no distribution in 1914 and 8 per cent. in 1913.

The Elektrochemische Werke, of Bitterfeld, most of whose installations and plant at Rheinfelden and Bitterfeld are leased to the Griesheim-Elektron Chemical Works, of Frankfort-on-Main, report gross profits amounting to £87,000 for 1915, as compared with £86,000 in 1914. Including the balance brought forward, the net profits are returned at £62,500, as against £62,100, and the dividend on the share capital of £275,000 is 10 per cent., as in the previous year. The share capital has been increased to £350,000, and is held entirely by the Zurich Bank for Electrical Undertakings.

The Gesellschaft fur Elektrische Unternehmungen, of Berlin, which is an investment company having a share capital of £3,000,000, and loans amounting to £1,997,000, states that the considerable interests held in enemy countries resulted in a reduction of £90,000 in the profits realised from dividends and interest in 1915, which was only partly equalised by profits of £40,000 resulting from sales of securities. The net profits and balance forward declined from £266,000 in 1914 to £216,000 last year, although the dividend is maintained at 6 per cent. for 1915, as in the previous year, whereas the rate in 1913 was 10 per cent.

The directors of the *Hamburg Hochbahn A.G.* report that the branch line to Rotenburgsort was handed over to the company by the Hamburg State on May 21st, 1915, and on that day the 40 years' concession commenced for the working of the circle line and the three branches to Eimsbuttal, Ohlsdorf, and Rotenburgsort. The electrical equipment of the last-mentioned line was accelerated, and the service started about the end of July. During the first four months of 1915 troops comprising 2,200,000 were carried free of charge, whilst the paying passengers transported numbered 35,800,000 in the whole year, as compared with 36,480,000 and 39,000,000 in the two previous years respectively. After meeting interest charges and placing £27,000 to the renewal fund, as against £28,000 in 1914, the accounts show a loss of £900, as contrasted with net profits of £32,000, and a dividend of 4 per cent. in 1914 and 5¼ per cent. in 1913.

The report of *Voigt & Haeffner A.G., of Frankfort-on-Main,* states that the company was engaged during the whole of 1915 on the manufacture of parts of munitions, although the production of the customary peace articles was maintained to a satisfactory extent. Neutral countries were much larger purchasers than in former years, partly influenced by the favourable rate of exchange. It was possible to find substitutes for the requisitioned metals in materials produced in the country in the case of many classes of manufactures turned out, and the delivery of these materials was so much facilitated that the company was able to secure a satisfactory turnover towards the end of the year, particularly in products made in bulk. The net profits were £97,000, as against £49,000 in 1914, and a dividend of 12 per cent. has been declared on share capital of £250,000, as contrasted with 8 per cent. in 1914.

West London & Provincial Electric Supply Co., Ltd.—The credit balance for 1915 is £3,038, and after paying 6 per cent. on the cum. pref. shares the balance is to be carried forward.

Chiswick Electricity Supply Co., Ltd.—After paying debenture stock interest, a dividend of 5 per cent. for 1915 is to be paid, carrying £435 to depreciation reserve fund account.

Calcutta Electric Supply Corporation, Ltd.—The units sold during the five weeks ended March 31st were 2,122,507, compared with 1,579,169 units in 1915.

Austrian Electrical Companies.

The Elektrizitats A.G. (late Kolben), of Prague, has decided to pay a dividend of 9 per cent. out of net profits of £52,000 in 1915, as compared with 7 per cent. and £38,000 respectively in 1914.

The Kabelfabrik und Draht Industrie A.G., of Vienna, reports gross profits of £124,000 for 1915, and net profits of £56,000, as compared with £43,000 in the preceding year. It is proposed to pay a dividend of 12 per cent., as against 10 per cent. in 1914.

The accounts of the *Kabelfabrik A.G., of Pressburg,* which has a community of interests with the before-mentioned Kabelfabrik, of Vienna, show net profits amounting to £31,000 for 1915, as contrasted with £24,000 in the previous year. The rate of dividend is 12 per cent., being an increase of 2 per cent. over 1914.

The accounts of *Felten & Guilleaume, of Pesth,* show net profits amounting to £20,000 for 1915, as compared with £17,900 in the preceding year. It is intended to distribute 12½ per cent., as against 10 per cent. in 1914. The directors' report states that the works are satisfactorily employed, chiefly on orders for the Army and Navy.

Swiss Electrical Companies.

The Elektrizitats Gesellschaft Alioth, of Basle, which two years ago transferred its manufacturing departments to another company, and then became purely an investment undertaking, reports gross profits of £17,000 for 1915, as against £14,000 in 1914, and net profits of £13,000 and £11,000 in the two years respectively. It is proposed to pay a dividend of 5 per cent. on the ordinary share capital of £240,000, as contrasted with 4 per cent. in 1914.

The Société Franco-Suisse pour l'Industrie Electrique, of Geneva, which is in close association with the group of the Banque de Paris, is unable to pay any dividend for 1915, as also was the case for the previous year, on the ordinary share capital of £1,000,000. The company is interested in railways and tramways, hydro-electric works, and electro-metallurgical undertakings, all of which are situated outside the war area. After meeting the interest service on the loans, amounting to £898,000, the accounts show net profits of £16,000, as against £4,600 in 1914. Most of the profit has been carried forward.

Johnson and Phillips, Ltd.

Mr. R. W. Blackwell, presiding on April 27th at the annual meeting, referred to the improvement in the accounts, which showed a trading profit of £69,077. In regard to the dividend of 5 per cent., free of tax, on the ordinary shares, he said that the conditions under which the business must be carried on for a considerable period to come did not admit of a larger distribution. They must carry very heavy stocks of material to meet the requirements of the Government. The position of the company was thoroughly sound and steadily improving. During 1915 they had spent on additions to buildings and plant £8,414. They had good reason, under existing conditions, to be satisfied with both the present position and the future prospects of the concern. So long as the war endured, it was more than probable that a large part of their plant would run at full pressure, but a considerable proportion of their machinery and plant which was not susceptible of adaptation to the present requirements might have to lie idle until normal conditions were again reached. He did not believe that their company had been either advantaged or injured financially by the war to any special extent. Their turnover might be somewhat higher than they might reasonably have expected, but the difficulties of doing business, prices and costs of all kinds, had greatly increased, and their margin of net profit decreased. A part of the new machinery that they had built would be of real utility to them when the demand for war material no longer existed. They proposed to continue in their endeavour to bring every part of the works and plant up to the best modern standard. Their stocks, though large, as they must necessarily be in these days, when there were great difficulties in securing material, had been well bought, and stood in the accounts at a safe figure. The chairman laid stress upon the fact that in the present abnormal state of all business the command of ready money was a first essential to the business of the concern. However quickly they might be paid for their goods when finished and delivered, the fact remained that they must buy their material well ahead, and on practically cash terms, and must carry its cost, plus labour charges, for the period of manufacture—say, an average of at least three months on every order received. The comparatively small dividend and the substantial carry-forward that they recommended were most advisable in view of the conditions under which their business must necessarily be carried on for an indefinite, but certainly a considerable, period.

Bath Electric Tramways, Ltd.

Sir J. Sivewright presided on April 27th at the annual meeting. He said that 1915 could not fairly be compared with any other year. The traffic and other receipts showed a decrease of £5,558. The decrease, however, was largely attributable to the reduction of the company's motors in the latter part of 1914, when a large number of them were transferred to the Government for military service. Economies in operation and in the expenses of the company more than offset the diminution in receipts, so that they had actually a greater net revenue for 1915 than they had in 1914. The foundry belonging to the company had been engaged on most useful work, and continued to give capital results. Operating, as they had been, for the whole of the year 1915 without a large part of their torpedo fleet, the results compared most favourably with those of the previous twelve months, for nine months of which they were working the whole of their torpedo cars. In 1915 the weather during the spring and summer was very unfavourable, but there was a decided improvement in the autumn, and of this the company felt the benefit. A lot of money had again been spent in repairs and renewals, and everything had been kept in good order. He did not refer merely to replacements or repairs such as were done annually; what had been carried out would last for many years. The company was in a position not only to pay its debenture interest and preference dividend, as well as to redeem debentures, but also to pay something off the loan from the Union of London & Smiths Bank, which had been very substantially reduced. Originally it was £28,000, and it had now been brought down to £16,000, and, although the shareholders had had to forego that £12,000, the value of their shares was improved to that extent. There was a promising future before the company, and if they pursued their present policy they would have an improved fleet and their foundry would be extended. Mr. A. A. C. Swinton seconded the adoption of the report, which was carried.

Western Electric Co., U.S.A.

The annual report of the Western Electric Co., Inc., which is in effect a reorganisation of the Western Electric Co., of Illinois, covers the operations of both the Illinois and the New York companies during the year 1915, thus giving the results of the continuing business without attempting to segregate that part which pertains only to the operations of the new company. The sales for 1915, the report states, were $63,852,000, as compared with $66,408,000 for 1914 and $77,533,000 for 1913. "During the latter part of the year, however," says President H. B. Thayer, "there was an increasing demand for our products, and the present prospects indicate a fair volume of business in 1916, following the general business activity of the country. The costs of our raw material have been very much inflated by the demand for similar material by manufacturers of war munitions or by interrupted supplies of such as usually come from abroad, which continually reminds us that the general business activity is largely founded upon the abnormal conditions abroad. These higher costs materially affect the costs of our manufactures, and when the return to normal conditions comes we may expect a considerable shrinkage in the value of such materials as we may have in stock at that time." The orders on hand, the report goes on to say, on January 1st, 1916, were $2,111,000 in value more than on January 1st, 1915. The average value of an order filled during 1915 was $55, as compared with $56 for 1914. The number of employés on January 1st, 1916, was 17,135, as compared with 15,650 on January 1st, 1915.—*Electrical World.*

North of Scotland Electric Light and Power Co., Ltd.

Considering the conditions, satisfactory progress was made in 1915. Lamp connections in Montrose increased from 1,114 kw. to 1,163 kw.; in Brechin from 738 kw. to 776 kw.; and in Inverness from 1,286 kw. to 1,452 kw., making a total of 3,391 kw. connected in the three towns. The gross profit, including £2,420 brought forward, is £9,458, and after meeting interest on debentures and loans amounting to £2,856, and writing off £57 from suspense account, a net profit of £6,546 remains. A dividend at the rate of 3 per cent. for 1915 is recommended, absorbing £1,500, £2,000 is to be placed to renewal reserve, £1,000 to general reserve, and £2,046 carried forward.

Babcock and Wilcox, Ltd.

The net profit for 1915 was £396,551, plus £69,492 brought forward. After paying dividends of 6 per cent. on the preference and 5 per cent. on the second preference shares for the year, 9 per cent. is to be paid on the ordinary for the past half-year, in addition to the interim dividend of 6 per cent. already paid; £150,000 is to be placed to reserve, and £10,000 to the staff pension fund, leaving £42,125 to be carried forward. The business has been a controlled establishment since August last. Additional premises were acquired during the year adjoining the Renfrew works, and other extensions have also been carried out. The company is, and has been, short of men, and is now introducing female labour in some departments. A large proportion of the staff joined the Forces, but the extra demands made on those remaining have been met with a spirit of enthusiasm. The company continued to contribute to the maintenance of dependents of the staff with the Forces. Annual meeting: May 9th.

Calcutta Electric Supply Corporation, Ltd.

During last year 21,081,928 units were sold, compared with 15,387,471 in 1914. The number of houses connected was 8,768, an increase of 588. The gross revenue was £224,206, as against £202,455 for 1914. The net revenue was £162,922 (as against £140,609 for 1914), calculating the exchange at 1s. 4d. per rupee. Adding the balance brought forward and interest received on money at deposit, the total is £176,602. After paying the interim dividend of 3½ per cent., actual, paid on the ordinary shares in November, 1915, the dividends paid and accrued on the preference shares, and the other

items in the net revenue account, the available balance is £122,177. £52,000 is to be placed to the credit of the depreciation and renewals account, £10,000 to the reserve fund, and a final dividend at the rate of 5¼ per cent. actual is recommended, making 9 per cent. for the year, leaving £30,000 to be carried forward after providing for the directors' extra remuneration of £2,500, and a bonus of £1,629 payable to the staff in India. The reserve for depreciation and renewals will thus be increased to £229,444, and the reserve fund, with the addition of £2,184 from dividends on investments, will stand at £126,704. The expenditure on capital account during the year amounted to £122,344, making the total outlay £1,380,827. The demand for electrical energy continues to increase steadily, and the result of the working for the year must be considered satisfactory. Units generated, 27,573,446; public lamps units sold, 476,373; sold by special contract, 613,271; lighting units by meter, 4,371,865; power units by meter, 15,620,419; used on works, 5,295,156; not accounted for, 1,196,362. Annual meeting: May 10th.

Consolidated Diesel Engine Manufacturers, Ltd.

The *Financial Times* states that another half-yearly statement by the liquidator has just been issued, bringing the record of the accounts up to January 6th last. In the interval the whole of the unsecured creditors have been paid off, leaving a balance of £52,800 in hand, so that the contributories are likely to receive a small portion of their capital back, but it would appear that there are still some uncompleted contracts in hand, and the cost of these may have to be set against the value of the remaining assets. "The liquidation has now reached the unprofitable stage, and the sooner that it is finally closed the better. For the six months the costs and charges amounted to £3,200, while the total receipts were only £1,700, so that there was a loss of £1,500. The collection of book debts has been particularly disappointing, only £10,400 having been yet got in out of £28,100 marked 'good' in the secretary's original statement, to say nothing of £69,300 scheduled as 'doubtful.' How far the war is responsible for this it is impossible to say, but we are afraid that not much value can now be attached to the company's Belgian interests."

Puebla Tramway, Light, and Power Co., Ltd.

The report for 1914 states (says the *Financial Times*) that the net profit in Mexico amounted to $692,499 Mex., as compared with $736,952 for 1913. Reckoning the earnings at the parity of exchange there is a debit balance—after charging all expenses, bond interest and first mortgage bond sinking fund —of £17,154, but owing to the heavy loss on exchange, which amounted to £42,996, the final result is a debit balance of £60,150. The average exchange was 13.78d., as against 24.5841d. par value and 21d. in 1913. At the date of this report the value of the peso is about 2d. The transmission line to Vera Cruz was completed and power delivered to that city at the end of the year, and commencing with January, 1915, a regular supply of power has been given to the Vera Cruz Electric Light, Power & Traction under contract. Except for a small amount of damage done by bandits from time to time and considerable thefts of copper, the company's properties remain intact. Owing, however, to the difficulty of operating the plants at Portezuelo and San Agustin, in face of continued interferences, these were closed in August, 1914, and the Tuxpango plant has since borne the entire load of the company's output. The business has suffered during the year on account of a large number of factories having been destroyed or closed down. Owing to the disturbed conditions of trade and the heavy fall in the exchange value of the Mexican dollar a meeting of the first mortgage bondholders was convened and duly held on July 30th last, when a resolution was passed sanctioning a modification of the rights of the bondholders.

Oriental Telephone and Electric Co., Ltd.

Sir Geo. Franklin presided at the annual meeting on April 26th. He said that one of their colleagues, Capt. Akers, was in France on military service. After explaining the sources from which the company derived its income, he said that the gross revenue from subscriptions, rentals, and sales was £55,336, an increase of £3,605, which was due mainly to development in Madras, Mauritius, and Singapore. Dividends and interest from subsidiary companies, £33,429, showed an increase of £1,696, due to larger dividends from the Bombay and China and Japan companies. The Bombay Co. now paid 20 per cent., and the China & Japan Co. 10 per cent. The working expenses amounted to £28,870, plus £9,656 for London expenses, which had been largely increased by heavier income-tax and excess profits duty. In regard to the charge of £5,500 against revenue for depreciation of securities, it was necessary to write off that amount in order to bring their War Loan and Cape stock well within the market prices on December 31st last. The balance to the credit of net revenue account was £61,957. With reference to the transfer to reserve, it should be borne in mind that telephone plant in tropical or semi-tropical countries was peculiarly liable to depreciation, not merely from ordinary wear and tear, but from other causes, such as the substitution of underground for overhead construction, developments in the art, typhoon storms, and many other contingencies of that kind. With regard to the Telephone Co. of Egypt, controlled by the Oriental Co., they had recently sent their consulting engineers to make a very careful investigation, and to report as to the state of the plant, &c., and its value. They hoped, also, to get much useful advice for the carrying on of the business. With the figures and the information which they hoped to get in that way they would have conclusive evidence as to the value of their plant and property, which they conceived to be very necessary at this time. Having done that with regard to Egypt, it might be necessary to extend it a little further, and to consider how far it was desirable to gain similar information as to the value of their plant, and the best means of developing other parts of the company's systems. While he did not want to commit the board to anything more than that, then, the shareholders would see the bearing that this had upon several questions which might arise out of what he was going to say. With regard to the Oriental Co., they were proposing to earmark, for the first time, £40,000 to the reserve fund for depreciation, and whereas last year they had a carry-forward of some £56,000, they were only proposing to-day to carry forward £15,000. But they were transferring £70,000 to a reserve fund account. The question as to how much, if any, of the £70,000 was profit, depended upon the investigation they were proposing to make. That investigation would enable them, first of all, to see whether their assets were worth the balance-sheet figures—the capital which had been expended on lines, exchange equipment, and telephone plant. He need hardly explain the absolute necessity of keeping the company strong and safe. One of the first things, and the last, which a telephone company wanted was new capital. It was the breath of life to it. Without new capital they were unable to take advantage of opportunities of development which were of vital importance. These were not times when they could get Treasury sanction to increases of capital. The first thing, then, was to see that the value of the assets was sound. Secondly, it would be for them to consider how far, if at all, there might be any probable distribution from this source. He referred to the difficulty which would be created if they were to deplete themselves of cash in order to make any distribution of that kind. The stores on hand and in transit had increased to £45,512 during the past year, largely due to £17,000 which was in cables for Singapore and Madras in transit on December 31st last. They had learned since that the cabling work in those two places was proceeding satisfactorily and would enable the company to meet the development from time to time. With regard to their subsidiary companies, the figures in each case showed good progress. The Telephone Co. of Egypt grew in strength and continued to pay its 10 per cent. dividend. The circumstances of the war had cast upon the company considerable responsibilities in the construction of lines for the service of the military. In Hong-Kong and Kowloon the China and Japan Co. had made good progress, the gross revenue being increased by £3,400. The Bengal and Bombay companies had each shown satisfactory development, though their figures were also somewhat affected by the war.

Anglo-American Telegraph Co., Ltd.—The three quarterly dividends on the ordinary and preference stocks paid in May, July, and November, 1915, absorbed £157,500, and including the final dividends paid in February, absorbed £262,500, being the rent paid by the Western Union Telegraph Co. for the year, equal to 3¾ per cent. on the ordinary stock, 6 per cent. on the preferred stock, and 1½ per cent. on the deferred stock. A bonus of 1s. 9d. per cent. on the ordinary and 3s. 6d. on the deferred stock was paid on February 1st, 1916. The balance at credit of revenue account, £67,153, includes £1,528 interest received, and the balance of £65,625 is available for dividends for the quarter to March 31st. Annual meeting: May 5th.

City Electric Light Co., Ltd. (Brisbane).—For the year ended January 31st, 1916, the credit balance is £20,133, after making additions to the franchise and purchase sinking fund, and renewal, replacement and contingencies account, and allowing for depreciation. An interim dividend was paid last September absorbing £8,987, and a further 3 per cent. has been paid on the preference shares, 5 per cent. on the ordinary, and 5 per cent. on the contributing shares; these payments, together with the dividend duty and an allowance for Federal income-tax, will absorb £10,892, leaving £1,569 to be carried forward.

A. Reyrolle & Co., Ltd.—The accounts for 1915 show a profit, after providing for depreciation, &c., of £11,853, there being an available sum, including £2,843 brought forward, of £14,696. Dividends of 13¼ per cent. on the preference shares and 18¼ per cent. on the ordinary shares have been declared, £5,000 being placed to reserve for general purposes and £3,396 carried forward.—*Financial Times.*

Alderley & Wilmslow Electric Supply, Ltd.—During 1915 the total lamp connections increased from 1,036 kw. to 1,092 kw. There is a profit of £3,064, plus £1,042 brought forward, and after paying £1,665 interest on debentures and loans, £2,442 remains, of which £1,200 is to be put to reserve fund and £1,242 carried forward.

Metropolitan Electric Supply Co., Ltd.—The ordinary general meeting which was adjourned until May 2nd or such later date as the committee might agree, will be held at a later date.

Indian Electric Supply & Traction Co., Ltd.—The surplus on working in Cawnpore during 1915, including £144 for interest accrued, was £15,932 (against £12,724 in 1914), and including further interest in England and transfer fees, the credit side of net revenue account shows a total of £15,992. London expenditure was £1,688 (against £1,537 in 1914), and after providing £3,900 for debenture interest a net profit of £10,264 is shown, plus £717 brought forward. Out of this, £2,000 has been placed to general reserve, £3,000 to reserve for depreciation and renewals, and £500 against expenses of the debenture issue. A final dividend of 3½ per cent., making 6 per cent. for the year, is recommended, absorbing £4,681, and £800 is to be carried forward. Annual meeting: May 5th.

Tramways & General Works Co., Ltd.—Including the balance brought forward, the amount now standing to the credit of the profit and loss account is £540, out of which the directors recommend the payment of a dividend at the rate of 4d. per share (less income tax), absorbing £333, and leaving £206 to be carried forward.

City of Buenos Aires Tramways (1904), Ltd.—A dividend of 1s. 3d. per share (at the rate of 5 per cent. per annum), less tax, for the three months ended March 31st is announced.

STOCKS AND SHARES.

Tuesday Evening.

Collapse of the Irish "rebellion" has done something to help the sentiment in the Stock Exchange, and with no more holidays in sight until Whitsun, markets should be able to settle down in earnest to such work as they can find. Business in securities may be affected to no small extent by that call to the Derby Groups which comes into operation at the end of the present month, but the Stock Exchange is not meeting difficulties half-way, and the future is left to look after itself.

Meanwhile, the pronounced strength of all issues connected with the cable industry is still the outstanding feature of the markets dealt with here, and to this must be added a readiness on the part of the public to buy most of the "chemical" shares. These last are being taken principally by Liverpool and certain of the manufacturing towns in the North, where the investor is eager for the offer of shares in companies of which Castner-Kellner may be taken as a fair example.

Continued strength is shown by the electricity supply shares. City preference and County preference are both ¼ better at 10½, though City "Lights" are ⅛ easier at 11⅞. There is still a demand for other good-class shares in this market, and, as we have pointed out before, comparatively little supply. A somewhat sensational rise is one of 12s. 6d. in Edison & Swan fully-paid shares, the price jumping to 1¾ upon persistent buying—or demand, rather, inasmuch as there have been few on offer and holders are by no means anxious to sell. The partly-paid rose 3s. to 12s. in sympathy. The market seems rather puzzled to account for advances so violent as these, but the buying proceeds from sources which should certainly know what they are about.

Babcock & Wilcox are firm at 2¾ bid, on the issue of the report. The raising of the dividend by 1 per cent. to 15 per cent. does not look a particularly brilliant achievement, but it has to be remembered that the distribution is made free of tax, and consequently the yield is higher than it appears. The company's net profit was actually £6,000 smaller than that for the previous year, the whole of this, and more, being due to increase in income-tax, for the gross profit showed an advance of £13,300. Castner-Kellners are better, in company with most of the chemical shares; and British Westinghouse preference hardened to 2¼. There is no quotable change amongst cable manufacturing shares, but the market is a good one.

Eastern Telegraph ordinary gained 1½, and small rises are shown by several of the other principal shares in this section. Marconis are dull, the recent bout of buying coming to an end somewhat abruptly. American Marconis are quiet at about 15s., while Canadians are 8s. 3d.

Latin-Canadian companies are doing well. The last published accounts show that satisfactory increases in earnings over the corresponding months in 1915 were secured by the Brazilian Traction, the Consolidated Gas and Electric Light, of Baltimore, and the Power companies of the Missippippi River, the Shawinigan and the Pennsylvania. From the market point of view, however, April was quiet, but there was a slight appreciation in prices on balance.

Within the past few business days has come a faint improvement in some of the Mexican prices, marked more in the railway departments than amongst utilities. The bonds of the Mexican Light & Power, and the Mexico Tramways are still all but unsaleable, though railway stocks have hardened in consequence of a jump in the price of silver that has taken it higher than it has stood for about a quarter of a century. The political situation in Mexico is little or no better, but if this were to take one of its unexpected turns—it could hardly be for the worse—Mexican utilities might make a vivid recovery. Seeing that the leading issues have suffered losses ranging from 20 to 45 points since the outbreak of war, there is at least scope for reaction, even when the succession of blows at the companies is remembered and appreciated. The period for deposit of the bonds in the Mexico Tramways Group of Companies has just been extended until the end of June.

Brazil Tractions are a point higher on the week at 56¼. Other Latin-Canadians are good. New York has got over its recent fit of apprehension with reference to the diplomatic situation between the States and Germany, and, furthermore, manages to extract some degree of confidence from the reported refusal of Washington to withdraw the American troops from Mexico at the instance of the Carranzist party.

Home Railway stocks dropped back into lethargy, for which the Irish situation was held to be responsible. Unfortunately, the market made no particular recovery upon the surrender of the rioters. It is jocularly suggested that the sudden inrush of summer weather may have something to do with the cessation of buying orders in Underground Railway stocks. These issues are all easier, Metropolitans being the principal losers. Business in the group as a whole is quiet.

Rubber shares, moreover, are much less active. The price of the raw stuff has gone back to the near neighbourhood of 3s per lb., and while such a factor would have weighed but little in an active market, it assumes importance when the upward movement shows signs of slackening. Armament shares hold their positions fairly steadily. Coppers are somewhat erratic, and in most of the other base-metal shares—silver alone excepted—the prevailing tendency leans towards dulness and rather lower values.

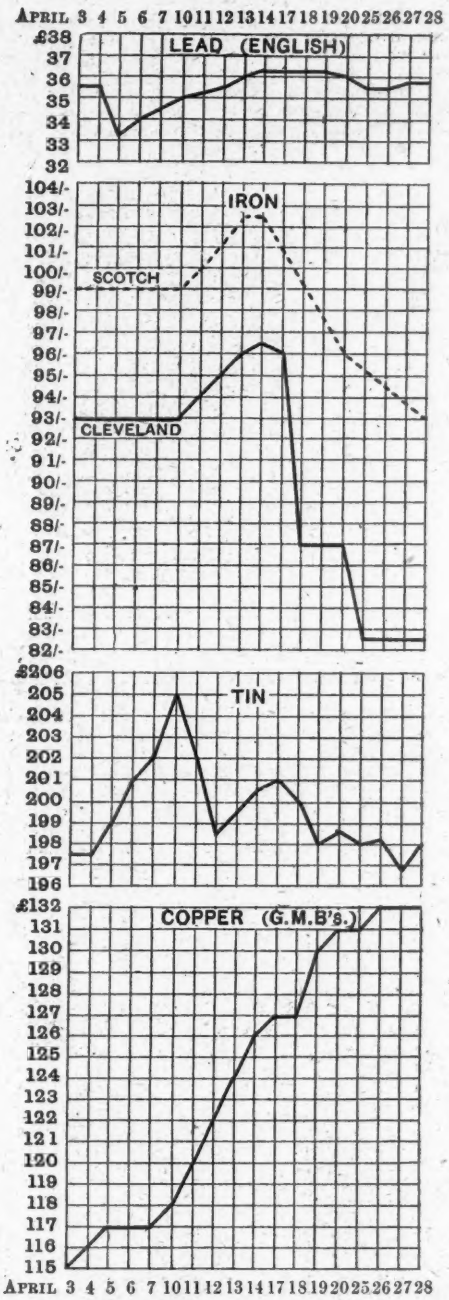
SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price May 2, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6⅜	—	£7 8 2
Charing Cross Ordinary	5	5	8½	—	7 18 10
do. do. do. 4½ Pref.	4½	4½	8½	—	6 18 6
Chelsea	5	4	7½	—	6 3 1
City of London	9	8	11½	— ¼	6 16 9
do. do. 6 per cent. Pref.	6	6	10⅝	+ ½	5 14 3
County of London	7	7	12⅛	—	6 13 4
do. 6 per cent. Pref.	6	6	10⅝	+ ½	5 14 3
Kensington Ordinary	9	7	5	—	7 0 0
London Electric	4	3	1⅜	—	7 6 4
do. do. 6 per cent. Pref.	6	6	4½	—	7 1 2
Metropolitan	3½	3	2⅜	—	6 6 4
do. 4½ per cent. Pref.	4½	4½	3	—	7 10 0
St. James' and Pall Mall	10	8	6	—	6 13 4
South London	5	5	2⅝	—	8 18 10
South Metropolitan Pref.	7	7	1⅛	—	6 14 0
Westminster Ordinary	9	7	6	—	5 15 8
Telegraphs and Telephones.	Dividend, 1914.				
Anglo-Am. Tel. Pref.	6		98 xd	—	6 2 3
do. Def.	33/6		21½	—	7 18 6
Chile Telephone	8		6½	— ⅛	6 8 0
Cuba Sub. Ord.	5		7⅞	—	6 9 0
Eastern Extension	7		14½	—	*5 12 4
Eastern Tel. Ord.	7		144	+1½	*5 11 1
Globe Tel. and T. Ord.	6		11⅜	+ ⅛	*5 3 4
do. Pref.	6		10½	+ ⅛	5 17 5
Great Northern Tel.	22		35⅛	—	6 4 3
Indo-European	13		50 xd	—	6 10 0
Marconi	5		2½	+ ⅛	4 14 4
New York Tel. 4½	4½		100⅜	—	4 9 4
Oriental Telephone Ord.	10		1⅝	—	6 6 8
United R. Plate Tel.	8		6	—	*6 13 4
West India and Pan.	1		1⅛	—	9 1 10
Western Telegraph	7		14½	—	*5 12 4
Home Rails.					
Central London, Ord. Assented	4		67⅛	— ⅞	5 18 6
Metropolitan	1½		25⅛	— 1½	3 18 6
do. District	Nil		18⅝	— ⅜	Nil
Underground Electric Ordinary	Nil		1⅜	—	Nil
do. do. "A"	Nil		5/6	— 6d.	Nil
do. do. Income	6		85½	— 1½	*7 0 9
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6		4⅞	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½		3⅜	—	7 6 8
do. 2nd Pref.	5½		3⅜	—	8 3 0
do. 5 Deb.	5		78	—	6 8 2
Brazil Tractions	4		56¼ xd	+ 1	7 1 7
Bombay Electric Pref.	6		10½	—	5 17 3
British Columbia Elec. Rly. Ptce.	5		53	—	9 8 8
do. do. Preferred	—		37	—	Nil
do. do. Deferred	—		33	—	Nil
do. do. Deb.	4½		62	—	6 17 1
Mexico Trams 5 per cent. Bonds	—		40	—	Nil
do. 6 per cent. Bonds	—		32	—	Nil
Mexican Light Common	Nil		20	—	Nil
do. Pref.	Nil		32	—	Nil
do. 1st Bonds	—		39	—	—
Manufacturing Companies.					
Babcock & Wilcox	14		2¾	—	5 9 1
British Aluminium Ord.	5		22/- xd	—	6 7 3
British Insulated Ord.	15		10½	—	7 2 10
British Westinghouse Pref.	7½		2⅛	+ 1/16	7 1 2
Callenders	15		11⅛	—	6 10 5
do. 5 Pref.	5		4½	—	5 17 8
Castner-Kellner	20		3⅛	+ 1/16	6 1 3
Edison & Swan, £3 paid	Nil		12/-	+3/-	Nil
do. do. fully paid	Nil		1½	+ ½	Nil
do. do. 5 per cent. Deb.	5		57	—	8 15 8
Electric Construction	6		16/-	—	7 10 0
Gen. Elec. Pref.	6		9⅜	—	6 4 8
Henley	20		14⅛	—	*6 13 0
do. 4½ Pref.	4½		4	—	5 12 6
India-Rubber	10		10	—	*10 0 0
Telegraph Con.	20		85½	—	*6 13 4

* Dividends paid free of income tax.

METAL MARKET.

Fluctuations in April.



The Metric System.—The secretary of the Decimal Association is informed by correspondents in the U.S.A. that at the opening of the present session of Congress, a Bill was introduced by Mr. C. H. Dillon, making the metric system of weights and measures permissive till July, 1920, after which date it is to be compulsory and exclusive. This Bill is being considered in Committee, and the members are reported to be much impressed with the facts that domestic business would be greatly facilitated by the more scientific system, and that commerce with all parts of the world, and especially with South America, would be sensibly promoted if a metric basis were accepted. It is evident, therefore, that the advantages to be gained from the adoption of the metric weights and measures are being fully considered in the U.S.A., and that we shall have to face serious competition and be more severely handicapped than ever if we remain the only civilised nation which has not adopted metric weights and measures and a decimal system of coinage. The change in the U.S.A. should be made more easily than in this country, as the people there are already accustomed to think in decimals.

Judging from the editorial comments of the *American Machinist*, many manufacturers object to the proposed reform, which carries with it punishment by fine or imprisonment for the use of weights and measures other than metric after July 1st, 1924.

THE LJUNGSTRÖM TURBINE AND ITS APPLICATION TO MARINE PROPULSION.

By ROLAND S. PORTHAM.

(*Abstract of paper read before the* Institution of Engineers and Shipbuilders in Scotland.)

Early in 1913, the favourable results achieved by the turbine associated with his name led Mr. Birger Ljungström, of Stockholm, in conjunction with his brother—Mr. Frederick Ljungström—to consider the question of electrical propulsion for commercial vessels. The pioneer ship, the *Mjölner*, of 900 s.h.p., with two generating units, each of 450 s.h.p., has been running since December, 1914, and the fuel consumption under the same conditions of deadweight, speed, and coal has averaged 38.6 per cent. less than that of her sister ship, the *Mimer*, fitted with triple-expansion reciprocating engines.

Messrs. Ljungström recognised that an important feature in marine propulsion was that the generating plant should be subdivided into at least two entirely independent units, so that either set could drive the ship at about three-quarters speed, running under relatively economical conditions. Natur-

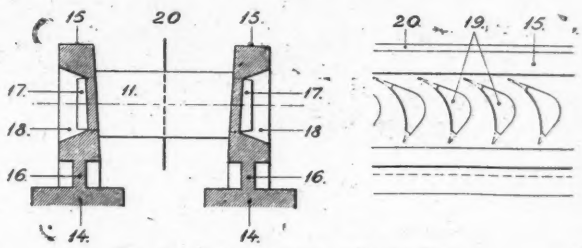


Fig. 1.—Construction of Blade Ring.

ally, this subdivision of power, though conducing to maximum reliability at sea, necessitates an efficient, light, and accessible turbine.

In 1907, Messrs. Ljungström came to the conclusion that the pure reaction principle offered certain advantages over the impulse type, more especially for turbines of larger output. The drawback, however, in the reaction system was the large number of rings and blades, involving a correspondingly long rotor to ensure a reasonable efficiency, and the

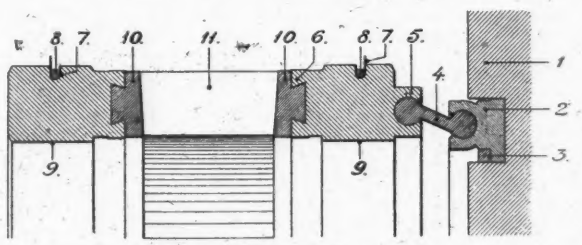


Fig. 2.—Section of Blade Ring.

attendant tendency to distortion of casing with varying temperatures, necessitating considerable tip clearances and corresponding leakages.

With a view to reducing such excessive length, Messrs. Ljungström experimented on various widths of blades, and found that these could be reduced to 5 mm. in the high-pressure end and to 17 mm. in the low-pressure end without affecting the efficiency. They realised, however, that shortening the turbine axially did not solve the problem of so adjusting the passage of steam through the blading as to allow it to follow its natural curve of expansion from a stop-valve volume of about 2¼ cu. ft. per lb. up to a volume of over 300 cu. ft. per lb., at a vacuum of from 28 to 28½ in. They, therefore, conceived the idea of turning the plane of the blade area through an angle of 90 deg., thus converting the direction of steam from axial to radial flow, and were thus enabled to proportion the areas of the successive blade rings so as to follow the true expansion curve of steam from turbine inlet to condenser. Simultaneously the great advantages were realised which would accrue were the guide blades in the ordinary turbine designed so as to revolve at the same speed as the moving blades, thus doubling the relative speed of the blade rings, and therefore necessitating only one-quarter the total number of rings for the same efficiency. Messrs. Ljungström concluded that the only satisfactory method of double rotation would be on the pure reaction principle of alternate concentric blade-rings, the steam reacting from the first blade ring to the next ring surrounding and concentric thereto.

As it was important that the clearance between the revolving rings should be as small as possible, the next step was

so to hold them in their supporting disks that any distortion consequent on the variation in temperature between the blade ring and the framework should be eliminated. The original idea was, therefore, conceived of carrying each blade ring on its own expansion ring, and embodying a series of expansion or breathing rings throughout all parts of the turbine subject to temperature differences.

The period between 1907 and 1909 was spent by Messrs. Ljungström in preparing the designs of all the essential details, and the results of their careful work were embodied, in 1910, in the first turbine constructed by them of 750 B.H.P., running at 3,700 R.P.M., which gave a trial steam consumption of 8.9 lb. per B.H.P. per hour, total temperature of steam 626 deg. F., vacuum 28.6 in., and 171 lb. per sq. in. absolute pressure on the turbine inlet-valve.

Since that date an aggregate of about 200,000 B.H.P., of a design practically identical with their first turbine, has been put in operation or under construction. Fig. 3 shows a 1,500-B.H.P. turbo-alternator, 16 ft. long overall, and 4 ft. 2 in. in diameter.* Two 3-phase alternators, each of half the capacity of the turbine, are coupled to opposite ends of the turbine, and run in opposite directions, at 3,000 R.P.M., the relative speed of the blades being 6,000 R.P.M. The running speed is half the critical speed, and there is no vibration in running up to full speed. The set weighs 15¼ tons. Fig. 4 shows a half longitudinal section of the turbine, the axis of which is X Y. Steam enters by the vertical pipes A A, and passes through the holes B B milled in the hub of each supporting disk to the innermost blade ring No. 1, then radially through the two series of blade rings to the last ring, No. 42, on its way to the condenser; 21 blade rings are fixed to the disk G R, and 21 to the disk G L. The disks carrying the blade rings are each divided into three sections, connected through expansion rings, to avoid the stresses and alterations in shape which would arise in a solid disk subjected to the influence of varying and irregularly distributed temperatures, as would be the case when steam was first admitted into the turbine, and when variations took place in steam pressure or temperature, or in the load. The disks are made of chrome nickel steel, and are mounted on the ends of the generator shafts, which, where exposed to heating by the steam, are hollow, so that the fluctuations of temperature in shaft and hub follow one another, and thus avoid play between the hub and the shaft.

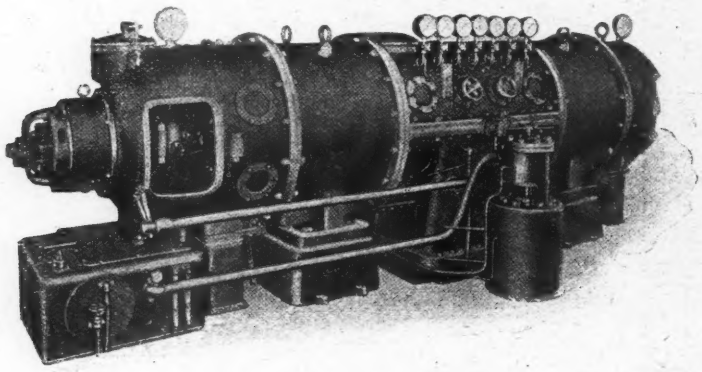


FIG. 3.—LJUNGSTROM TURBO-ALTERNATOR.

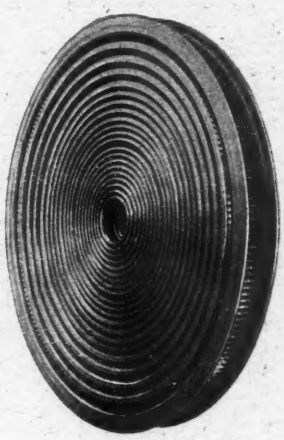


FIG. 5.—SET OF 21 RINGS.

A general inspection of the half longitudinal section shows a number of small dumb-bell-shaped sections. These are not links, but cross-sections of circular rings made of nickel steel. They are the expansion or breathing rings previously referred to, which form one of the essential features of the turbine, and are interposed between any two parts which would be otherwise liable to distortion due to variation of temperature. These expansion rings are interposed between the blade rings and supporting disks, between the component parts of the disks themselves, and between the steam chests and their supporting frames.

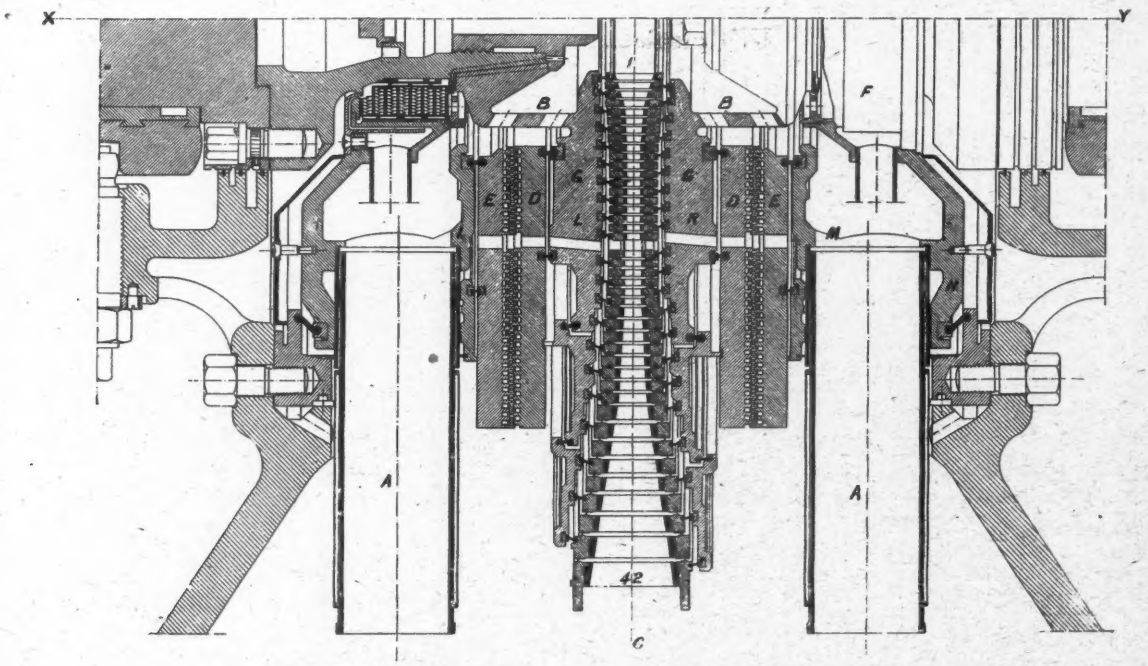


FIG. 4.—HALF LONGITUDINAL SECTION OF LJUNGSTROM TURBINE OF 1,500 B.H.P.

Figs. 1 and 2 show the method of construction of the blade rings. The blades are made of 5 per cent. nickel steel. Counting from the centre line, X Y, fig. 4, the first 33 rows are 5 mm. wide, the next five are 7 mm., and the last two 12 mm. and 20 mm. respectively. The blades are milled from solid rough-turned bars and polished to a mirror-like surface both inside and out. They are then cut into lengths (11), fig. 1, and are notched on the ends for insertion into

* An illustrated description of the Ljungström 1,000-KW. turbo-alternator as made by the Brush Electrical Engineering Co., Ltd., appeared in the ELECTRICAL REVIEW of October 10th, 1913.

mild steel retaining frames (15). A side view of such retaining frames is shown with registers or slots to receive the blades (19). The turbine blades are retained in their positions by means of thin sheet-iron strips (20), in which are punched holes of the same cross-section as the blades, and at a distance corresponding to the pitch or spacing of the blades. These strips are applied in their places simultaneously with the assembling of the blades in the retaining frames, the angles of the blades being thus properly set, and the blades prevented from shifting during the welding operation. The blade ends are welded up solid in their frames by melting iron wire under the oxy-acetylene blow-pipe, thus filling up the channels (18). The blade ring thus obtained is then turned up in a lathe, giving the dovetail shape (10), fig. 2, and the sheet iron strips are cut away. Strengthening rings (9), fig. 2, made of the finest grade spring-steel are then dovetailed into the blade ring, and the edges squeezed in so as to grip the dovetail tightly, by means of hinged rollers carried on the lathe tool rest. A groove is formed in one of the strengthening rings (9), to receive the dumb-bell-shaped expansion ring (4), the other end of the dumb-bell being rolled into the seating ring (2), which is subsequently fixed to the supporting disk, to which it is secured by a caulking strip (3), fig. 2. Each blade ring is now complete, with the exception of two pure nickel fins (7), fig. 2, which are caulked into the top surface of the strengthening rings by two pieces of soft iron wire (8). The function of the nickel fins is to prevent side leakage from any pair of counter-rotating blade rings. Fig. 5 shows the completed series of 21 rings ready for insertion in the supporting disk.

Referring again to fig. 4, it will be obvious that the steam entering the centre and flowing through the series of turbine disks to the condenser, will displace each rotating half axially outwards relatively to the other, unless this is counteracted by a corresponding reverse pressure. This is effected by a series of labyrinthic dummies E D, of which D is attached to its respective rotating disk through three expansion rings, and revolves with it; whilst E is fixed to the stationary part of the steam chest. Steam is admitted between these dummies from the centre of the turbine. The inner labyrinthic packings receive the full steam pressure, the pressure gradually decreasing from the centre until it finally drops to that of the condenser outside of the outermost labyrinth. Each rib of the fixed dummies has a small groove on its outer face, into which a folded strip of thin nickel is lightly driven.

These labyrinthic dummy packings form a very accurate method of balancing the axial thrust. Should the load increase in the turbine, the revolving labyrinthic face D approaches the fixed face E, thereby increasing the space between the nickel strips, and causing high-pressure steam to enter between E and D, forcing D in the opposite direction, and automatically closing the labyrinthic openings. A small dashpot is fixed to the end of each rotor shaft for the purpose of damping any oscillatory movement which would otherwise occur. The shaft packings F, fig. 4, which reduce shaft leakage to a minimum, are of nickel steel, designed to expand freely in all directions without distortion. Packing for a 1,500-B.H.P. turbine occupies a length of less than 3¼ in. of the shaft, but contains no fewer than 158 constricting surfaces. The actual leakage through these glands is less than 1 per cent. of the maximum output of the turbine, but this is not wasted, as a separate pipe leads it to the feed-water heater, where it is economically utilised.

L M, fig. 4, shows the overload by-pass, which introduces high-pressure steam direct into the outer blade rings through a series of 60 holes drilled circumferentially in the supporting disk.

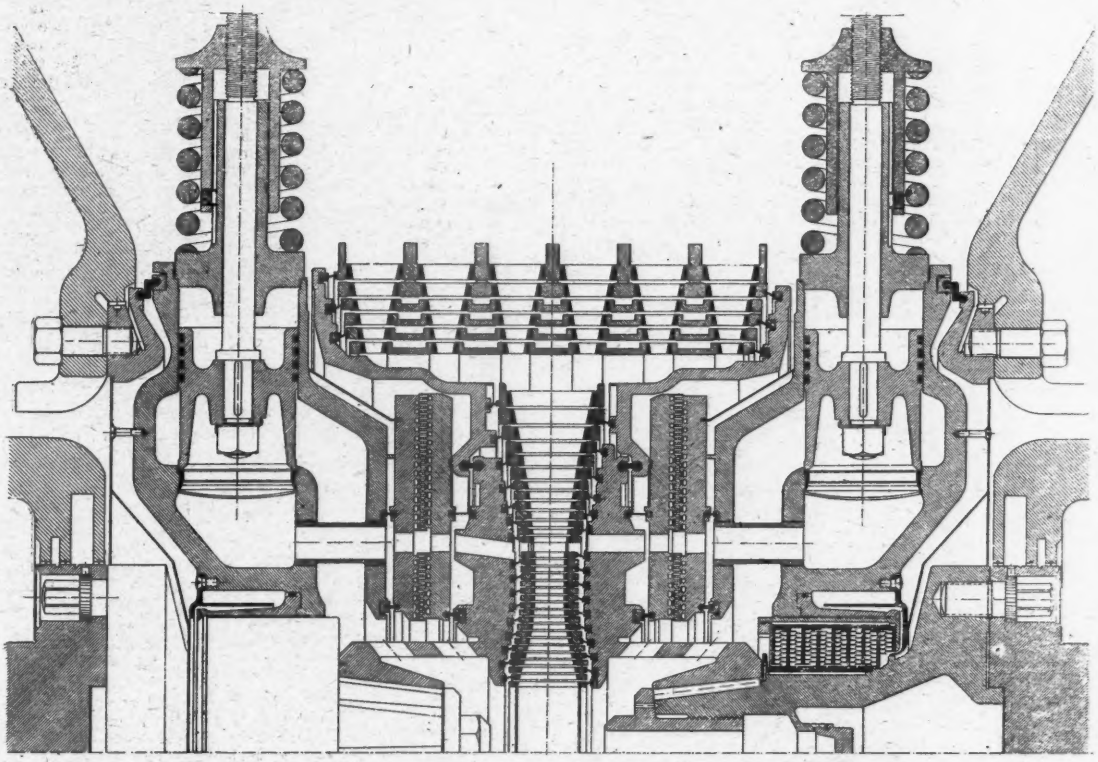


FIG. 6.—HALF LONGITUDINAL SECTION OF LJUNGSTROM TURBINE OF 10,000 B.H.P.

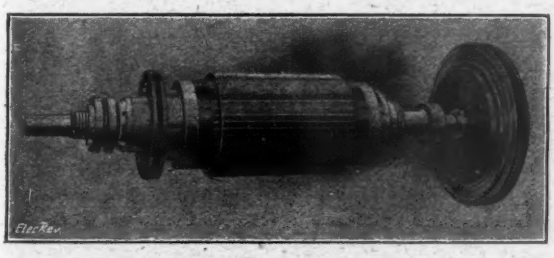


FIG. 7.—ROTOR OF 1,500-B.H.P. TURBINE.

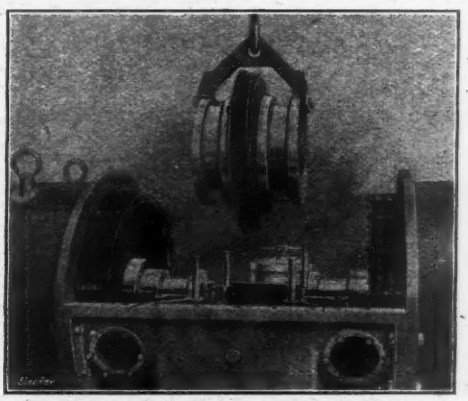


FIG. 8.—TURBINE, WITH STEAM CHESTS.

The shaft bearings of the turbine are provided with delicate methods of adjustment by four adjusting screws fitted with hemispherical heads (fig. 9). Each adjusting screw is provided with a pair of locking washers on which are 12 and 11 holes respectively, thus giving 132 different positions for each turn of the adjusting screw, corresponding to a thread with a very fine pitch. An eccentric ball admits of axial adjustment by turning its corresponding screw.

All bearings are automatically lubricated by oil under forced pressure. It is impossible to start the turbine unless the bearings are lubricated at their normal oil pressure, as should for any reason the oil supply fail, the turbine will automatically shut down.

The oil pump is of the ordinary geared type, driven directly by the governor spindle, and maintains a pressure of 35 lb. per sq. in., which is lowered to about 15 lb. for the bearing lubrication by means of a reducing valve. The throttle valve is normally pressed to its seat by means of a powerful spiral spring acting vertically downward. On the lower side of the valve spindle is attached a double-beat piston. The oil pressure acts on the bottom side of this piston, and consequently has to work against the spiral spring in order to open the throttle valve. Thus any variation in oil pressure varies the position of the throttle valve, which, through a floating lever and side shaft, maintains a constant relationship between the position of the stop valve and that of the governor, fig. 9, which is of the Chorlton Medlock type.

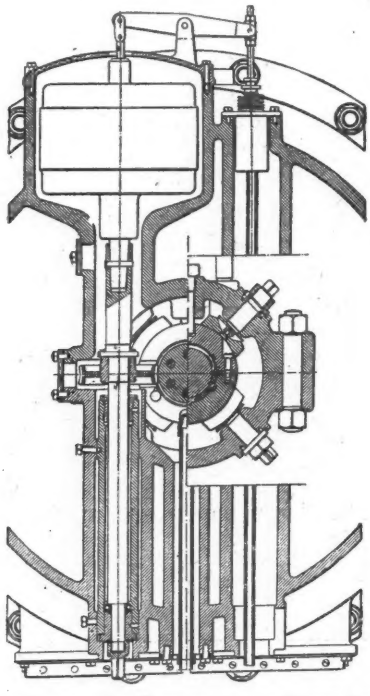


Fig. 9.—Section of Governor and Shaft Bearing.

An emergency release device is supplied by a steel cable which, so long as it is in tension, holds shut an oil relief-valve in the relay controlling the stop-valve; in the event of the turbine attaining an excessive speed or the bearings becoming unduly heated, the cable slackens, thus releasing a lever at the side of the stop-valve; this releases the oil pressure, the tension spring operates, and the turbine stops.

To start the turbine, the handle at the top is unscrewed a couple of turns, so as to admit sufficient steam to raise the disk valve from its seat, allowing steam to leak past the double-beat piston-valve, which is quite sufficient to warm up the turbine in a few minutes. A few strokes of the hand pump raise the oil pressure sufficiently to lift the piston on the valve spindle against the downward pressure of its spring, so that the turbine starts, and when once it has attained its maximum speed the regulation becomes automatic.

The generators are of very substantial construction, the whole machine forming a rigid cylindrical structure, which is adequately supported on the condenser inlet, thus forming a direct path without the necessity of intermediate joints. As the turbine casing is itself part of the condenser chamber, it requires no external lagging.

A ventilating fan attached to the rotor of each generator draws in air through a special inlet and propels it through slots in the stator, and through the air-gap between stator and rotor, to an outlet, whence it can be conveniently led through ducts to the forced-draught preheater in the boiler, dispensing with a separate fan engine. Fig. 7 illustrates the 1,500-B.H.P. turbine, the steam chests being removed, coupled to one rotor.

The relative lightness of the rotating parts of the Ljungström turbine, coupled with their mechanical construction, should dispel any criticism respecting the overhang. In the case of the 1,500-B.H.P. machine, the weight of each revolving part, that is, turbine rings, supporting disk, and attached labyrinthic packing, is only 265 lb. and 303 lb. respectively, while the maximum overhang to the outside of the bearing is 10¼ in.

Fig. 8 shows the 1,500-B.H.P. turbine complete with its steam chests being lifted out of the casing, and separated from its generator rotors. The total weight of turbine and steam chests is about 1,300 lb. The complete turbine can be removed for inspection, and opened up in two hours. The overall diameter is 29 in. and overall length across the steam chests 27½ in.

No insulating jackets need be removed to make bolts and nuts accessible. The internal parts of the turbine are made accessible by lifting off the upper part of the turbine casing. The couplings between the generator shafts and the turbine wheels are then unscrewed, and a clamp is applied to the steam chests. By the aid of this clamp the whole turbine and its steam chests are lifted together.

Fig. 6 shows a longitudinal half cross-section of the largest Ljungström turbine actually completed, the maximum output being 10,000 B.H.P., and speed 3,000 R.P.M. The diameter of the outer blade-ring is 34 in. The width of the outer rings necessary to give the required blade area is here obtained by building up a series of six independent blade rings, thus giving a sufficient stiffness to the drum as a whole. Each ring is connected with its neighbour through an expansion ring dovetailed and rolled together.

(To be concluded.)

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Lightning Arresters.

A recent list issued by the British Thomson Houston Co., Ltd., Rugby, describes the type M form D_2 lightning arrester for direct-current circuits. It consists of a single spark gap with a non-inductive resistance in series constituting the discharge path to earth: the spark gap is protected by a magnetic blow-out coil connected in parallel to part of the resistance, and should any current from the supply system follow the lightning discharge and tend to maintain the arc, a portion of such current will pass through the blow-out coil, producing a magnetic field tending to blow out the arc. The spark-gap terminals are threaded, allowing of adjustment; the box and cover are made of brown glazed porcelain, and the exterior view is shown in fig. 1.

Easy Clip Shade Carrier.

Messrs. Siemens Bros. Dynamo Works, Ltd, of 38, Upper Thames Street, E.C., have placed on the market a new shade-carrier of neat design, which simplifies shade fixing. This carrier is shown in figs. 2 and 3; it consists of two sets of claw grips, the inner ones to engage the screwed part of the lampholder and the outer ones to grip the shade. The clip is compressed by hand and forced into the top of the shade, where it holds in position; the shade and clip together are then forced over the lampholder, when the inner grips engage with the thread on the holder. The shade is removed by unscrewing, and it is not possible to remove it otherwise, as the grips act in opposite directions.

Fig. 1.—B.T.H. Lightning Arrester

Fig. 2.—Easy Clip Shade Carrier.

Fig. 3.—Easy Clip Shade Carrier in Position.

This clip renders the fixing of deep shades an easy matter, and when in position it presents but little difference in appearance from the ordinary shade ring.

Helsby Zinc Rods.

The British Insulated & Helsby Cables, Ltd., of Prescot, have sent us particulars of their special zinc rods for Leclanché cells. The ordinary rods of uniform section are usually eaten away chiefly at a point one-third of their length from the bottom, and consequently much zinc is wasted, especially in the stump which remains at the top. The Helsby zincs are therefore made thinner at the top and thicker over the lower half of their length, so that the material is more efficiently used, and an equal life is attained at reduced cost.

HYDRO-ELECTRIC DEVELOPMENT IN AMERICA.

The following notes are extracted from an address by Mr. Maurice Deutsch, delivered at the recent Pan-American Scientific Congress, and abstracted in *Power* :—

At present the total hydro-electric development of Niagara Falls is only 455,000 H.P. by five power companies. The average flow of the Niagara River is estimated at 222,400 cb. ft per second, or about 25,000,000 tons per hour. Considering the total fall in the river from half a mile above the Falls to the Pool below as being 216 ft., there is, theoretically, available a total of 5,700,000 H.P. Assuming a turbine efficiency of 87 per cent. (this has recently been carried to about 93 per cent.) and a generator efficiency of 92 per cent., the average available power would be about 4,500,000 H.P. This may be reduced by reason of friction losses, &c., to a net 4,300,000 H.P.

Three of the most interesting waterfalls in the world are to be found in South America—the Iguazu, Nacunday, and La Guayra. The Iguazu is probably the most important, its height and the volume of water being greater than those of Niagara Falls. It enters the upper Parana River about 1,500 miles from the Atlantic Coast, at the junction of Argentine, Brazil and Paraguay, and lies in the midst of a primeval forest. It is estimated that about 28,000,000 cb. ft. per minute bursts through a series of thickly wooded islands, and makes a clear leap at this point of 210 ft. into the gorge below.

About 200 ft. above the entrance of the Iguazu, on the Parana River, are the Falls of La Guayra, 310 ft. high, with an estimated flow of over 13,000,000 cb. ft. per minute. The physical conditions around this fall make it in every way a natural water power requiring only the installation of power-houses and penstocks. Although the journey from the Atlantic Coast to this falls takes about 12 days, the straight-line distance to the Atlantic Coast markets is not more than 400 miles. This entire country is wealthy in timber and other natural resources, awaiting only the assistance of capital for its exploitation..

In the United States the most remarkable development in recent years is that of the Big Creek, a tributary of the San Joaquin River, on one of the most inaccessible sites in the Sierra National Forest Reserve, 250 miles north-east of Los Angeles, California, and at an elevation of 7,000 ft. above sea level. The snow water from mountains 10,000 ft. high is stored and fed to two power plants, utilising in turn heads of nearly 2,000 ft. in horizontal distances of 2 miles to the first station, and 4 miles to the second. Power is transmitted 241 miles to Los Angeles at 150,000 volts, for industrial, lighting, and street-railway uses. The present plant has a capacity of about 80,000 H.P., but it is ultimately to be developed for 400,000 H.P.

The Coosa River project is the first of a number of hydro-electric developments by the Alabama Power Co. in Central Alabama, about 40 miles from Birmingham. The maximum distance of transmission is 150 miles. This company is largely financed by English capitalists. The present power house will provide for the installation of six 12,500-H.P. units operating under a 68-ft. head and at a voltage of 110,000. The ultimate capacity will be 400,000 H.P.

In power output, and especially in physical magnitude, by far the largest hydro-electric power plant in the world is that at Keokuk, Iowa, on the Mississippi River. The ultimate installation contemplates 30 turbines, each having a rated capacity of 10,000 H.P. at the normal head of 32 ft. At the maximum head of 39 ft. the output of each of these will be about 14,000 H.P., and at the minimum operating head of 20 ft., approximately, 6,000 H.P. The operating voltage is 110,000.

One of the largest water powers in the United States will be the Mount Shasta Power Co.'s development now in progress on the Pitt River, at the head of the Sacramento Valley. Its position will enable it to furnish power to the mining interests and mountain railroads of Northern California and to all towns and cities as far south as San Francisco and Oakland at a maximum transmission distance of 224 miles. Interesting features are the largest water-power tunnels in the world—16 × 19 ft. and 36,753 ft. long. The distance from the intake portal of the tunnel to the power house will be not quite 9 miles.

An important hydro-electric development in Brazil is the Pirahy plant of the Rio de Janeiro Light and Power Co., on the Lages River. The original plant had six vertical impulse wheels of 9,000 H.P. each, the maximum distance of transmission being 51 miles. As a result of the rapid growth of the cities served, the demand has exceeded the original capacity of 54,000 H.P. and the power house has been enlarged so as to make room for the two largest impulse turbines built to date, each capable of producing 20,000 H.P. at a speed of 300 R.P.M. under a net head of 900 ft.

In 1914 the Sao Paulo Electric Co. started its plant at Sao Paulo, Brazil. The present capacity is 40,000 H.P., and current is transmitted 56 miles at 88,000 volts, to Sorocaba and vicinity. Ultimately, it will have a capacity of 67,000 H.P. One of the units in this plant has a capacity of 14,500 H.P. under a head of 600 ft.

While formerly gravity waterwheels were used to a greater extent than reaction or impulse wheels, the practical water prime movers to-day have been reduced to two—the Francis turbine and the impulse wheel. These have been applied to a range of head from 6 to over 5,000 ft. With the marked advance in the workable speed of these machines, it is now possible to develop water power under heads heretofore considered impracticable. A single-runner high specific speed mixed-flow Francis wheel has recently shown an efficiency of 93·7 per cent.

The largest single units so far constructed are the 17,000-H.P. vertical Francis turbines installed at Tallulah Falls. These operate under a head of 600 ft. Manufacturers now declare that 40,000-H.P. units are quite practical if the demand arises.

Niagara Falls power is transmitted to Syracuse and to Oswego at 60,000 volts. The Southern Sierra Power Co. transmits power from Bishop, California, to San Bernardino, California, 238 miles, at 150,000 volts. The Province of Ontario has been delivering Niagara power 130 miles and has continued its line to Windsor, a distance of 235 miles, at 110,000 volts. Already improvements are at hand permitting a still larger transmission at a voltage of 150,000. The standard generating voltages are 2,200, 6,600 and 11,000, the choice being governed by the speed and capacity of the plant. Standard transmission voltages are 11,000, 33,000, 66,000, 110,000 and above, depending on the amount of power and distance transmitted.

A few years ago the greatest trouble was had with high-tension transformers, but American manufacturers have now entirely overcome this. In some of the biggest foreign plants the engineers have found it desirable to come to the American manufacturers for transformers even when the rest of their plant was of home manufacture.

Thirty-one plants operate at or above 100,000 volts. One-half of these are on the American continent and most of them in the United States; all but one are three-phase plants. About 40 per cent. of the total number are operated at 60 cycles, 30 per cent. at 50 cycles and the rest at other periodicities, mostly 25 cycles. There seems to be a strong tendency to use single-phase units in the transformers, although a few plants use the three-phase type.

Lamps by Post.—According to the *Central Station*, the Rochester Railway & Light Co., of N.Y., has for some months been using the U.S. mails for the delivery of incandescent lamps, and has found a reduction in cost over the old method of electric auto-delivery. Pre-cancelled stamps are used to avoid handling. During four months, 26,000 incandescent lamps—70 per cent. Mazda—have been delivered by parcel post and about 20 lamps were broken in the first month, owing to careless packing.

Colliery Worker Fined.—A rope lad at Manton Pit, Worksop, named Tom Brailsford (17), held up the mine for over half-an-hour by making an electrical connection with a piece of wire, which set the alarm bell ringing and stopped the haulage engine. At the Worksop Court, Mr. E. G. Warburton, who prosecuted the lad on behalf of the Wigan Coal & Iron Co., said his action had held up over 40 tons of coal, and stopped 80 men for the period named. Defendant's excuse was that he had headache and did not know what he was doing. It was shown that although only 17, defendant could earn over 35s. a week and a fine of £2 was imposed.—*Sheffield Telegraph.*

Rheinfelden Power Transmission Works.—The report for 1915 of the Kraftubertragungs Werke, of Rheinfelden, on the Baden-Swiss frontier, is of interest, inasmuch as it would appear that nearly the whole of the undertaking situated on Swiss territory has been disposed of to the Canton of Aargau. A special law, which was passed by this State some time ago, ordained that the supply of electrical energy to the inhabitants must be vested in the State by the creation of a special department for this purpose, which was to be brought into operation on January 1st, 1916. The report of the Transmission Co. shows that an agreement was reached with the Canton during last year, whereby the State took over the former's contracts and concessions in Aargau which apply to the supply of energy in Switzerland, whilst on its part the company agreed to supply current to the Canton in bulk at a low price for a period of 20 years. In addition to the primary and secondary network of mains, the transfer to the State includes 26 transformer stations and apparatus, as well as the large direct-current converter station which was established for the town of Rheinfelden, together with a battery of accumulators. Most of the purchase price was paid last August, the balance becoming due early this year. The portion of the company's Swiss undertaking which has not been acquired by the State of Aargau, which served for supply in the district of Basle and to Laufenburg, has been disposed of in another manner. The company's accounts show net profits of £52,000 for 1915, as against £54,000 in 1914, and the dividend is 8 per cent., as in the previous year.

INDIAN NOTES.

[From our Indian Correspondent.]

Mysore Electric Power Schemes.—The *Associated Press of India* reports that in view of the growing demand for electric power in Mysore, the chief electrical engineer, Mr. S. G. Forbes, has formulated two projects to supplement the present works at the Cauvery Falls. They are known as the Shishwa and the Kededatu Schemes, estimated to cost 67 lacs and 30 lacs respectively Power from these would feed the existing transmission cables. Increased production up to 40,000 H.P. is provided for with a further possible increase up to 50,000 H.P. In discussing a paper on the subject before the Mysore Engineers' Conference, Mr. Forbes, besides forecasting a possible supply of 3,000 to 4,000 H.P. to Madras City, points out that the railway from Bangalore to Mysore can be electrified. He thinks the schedule of trains over this 87 miles' run could be so arranged that the consumption would be fairly uniform at an average of 1,000 H.P. throughout the day.

Amritzar City Lighting Scheme.—His Honour the Governor of the Punjab performed the opening ceremony of this electric power and lighting scheme on March 15th. Originally, this was intended to be a canal fall scheme, but subsequently it was decided to have it a self-contained one, using Diesel engines. The contracts were signed with Messrs. Siemens Bros. in September, 1914; considerable delays were caused by the war, and it is considered that excellent work has been done in finishing the principal contract even within eighteen months. The total capacity of the plant at present is 360 KW., consisting of three units of 120 KW. each, with room for extensions later. The Municipality has borrowed the capital, 4½ lacs of rupees, from Government at 4 per cent. interest. It is hoped that when the scheme is fully working, in addition to repaying the loan and its interest, the undertaking will pay a good dividend to the Municipality, and that at the end of 20 years the scheme will be the Municipality's own.

A great measure of popularity has already been attained, and if the demand goes on increasing at its present rate, it will soon be necessary to add more generators.

The scheme was initiated by Mr. Miller Brownlie, municipal engineer; the supervision and technical details were carried out by Mr. Greenwood, the electrical engineer, who has been mainly instrumental in bringing about a speedy completion of the useful project.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SWITZERLAND.—By a Decree of the Swiss Federal Council, the exportation has been prohibited as from March 8th of manganese, chrome, molybdenum, titanium, uranium, vanadium, and tungsten, in so far as exportation is not already prohibited.

NORWAY.—A Customs Circular (No. 9 of 1916) states that the prohibition of the exportation of zinc applies also to (1) zinc ashes, (2) zinc scoriae, (3) zinc powder, (4) "sinkgröt," and (5) hard zinc.

SPAIN.—A Royal Decree, dated March 18th, authorises the Government to permit the establishment, by Spanish companies constituted in conformity with the Commercial Code, and at such ports as may be convenient, of bonded commercial warehouses. Goods may not remain within these warehouses longer than four years, after which period they must be exported abroad or entered for consumption in Spain. Certain operations may be performed within these warehouses (under supervision), including all those (with certain specified exceptions) which increase the value of the warehoused goods without essentially altering their nature.

Goods which enter these warehouses are to be exempted from transport duties, port duties, &c., as also are foreign goods re-exported from warehouse. Spanish goods which are exported to foreign countries through these warehouses shall be liable to transport duties and port dues, and also to export duties if such duties are leviable on the class of merchandise concerned. Goods from these warehouses which are passed into Spain are to pay import, transport, and other duties as if they had been imported direct from abroad.

BRITISH DOMINIONS AND POSSESSIONS.—A Supplement to the *Board of Trade Journal* of April 13th contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported to various destinations from British India, Canada, New Zealand, South Africa, Egypt, Malta, Cyprus, Mauritius, Ceylon, Straits Settlements, Hong-Kong, Nigeria, Gold Coast, Jamaica, Barbados, Trinidad and Tobago, and British Guiana. The information in the present Supplement supersedes that given in the Supplement published on January 13th last. Copies of the Supplement may be obtained, at the price of 3d. per copy (post free 4d.), from the usual sale agents for Government publications.

PERU.—Two Laws have recently been promulgated establishing export duties on copper and other mineral products. The duties are payable in 90 days' bills on New York or, at the option of the shipper, in the equivalent thereof in bills on London. The duties may be paid in sterling when the sum payable does not exceed £40. Producers and exporters are required to declare the nature and grade of their products.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co. Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

5,582. "Foundation and floors for storage batteries and for vats and tanks containing acid or corrosive solutions." R. H. Bryans & J. S. Highfield. April 17th.

5,586. "Junction box." W. A. Sutton. April 17th.

5,596. "Intercommunication telephone systems." J. W. Dungey & C. B. Kersting. April 17th.

5,606. "Electrical means for indicating or transmitting movements." H. R. Wright. April 17th.

5,613. "Dynamo-electric machines." British Thomson-Houston Co. (General Electric Co., U.S.A.). April 17th.

5,628. "Electrolytic method for removing oxide or rust from iron or steel." P. Marino. April 17th.

5,631. "Sound detection." R. F. Bossini & H. R. Wilding. April 17th.

5,634. "Sound detectors or transmitters." R. F. Bossini & H. R. Wilding. April 17th.

5,637. "Tablets for train signalling on single lines of railway worked on the electric-train tablet block system." E. Roberts. April 17th.

5,646. "Electric plug connectors." F. G. Baily. April 18th.

5,675. "Controlling systems for electric lighting." T. McLeod. April 18th.

5,682. "Electrolytic extraction of zinc." Metals Extraction Corporation and H. L. Sulman. April 18th.

5,750. "Electrolytic refining or extracting processes." United States Metals Refining Co. April 19th. (U.S.A., April 20th, 1915.)

5,769. "Mine, &c., signalling." Automatic Telephone Manufacturing Co. April 20th.

5,773. "Gas alarm and telegraph." J. M. Meadows. April 20th.

5,777. "Electrically-operated friction hoists." J. Scott. April 20th.

5,807. "Distance-operated mechanisms and signals connected to electric supply systems." H. E. Angold, W. Duddell, A. H. Dykes, H. W. Handcock & C. Oliver. April 20th.

5,834. "Preventing rapid exhaustion of primary batteries." T. McLeod. April 20th.

5,841. "Electrical systems for engines." C. F. Kettering. April 20th. (U.S.A., June 24th, 1915.)

5,842 "Dynamo-electric machines." British Thomson-Houston Co. and F. P. Whitaker. April 20th.

5,847. "Illuminated signs or electrographs." E. J. Kingsbury. April 20th.

5,858. "Electric fuses." A. F. Berry. April 20th.

5,859. "Electric heat radiators." A. F. Berry. April 20th.

5,860. "Electrical relays and their application." W. M. Mordey. April 20th.

PUBLISHED SPECIFICATIONS.

1915.

3,364. Manufacture of Electric Insulating Materials and the like. W. E. W. Richards. March 2nd.

5,007. Spring Arrangements, especially for use in Electric Making and Breaking Devices. Landis & Gyr Akt. Ges. March 31st. (April 2nd, 1914.)

5,079. Dynamo-electric Machines. R. Boin. April 1st.

5,088. Relays especially for Metering in Telephone Systems. E. Shibko. April 1st.

5,200. Electro-magnetically Operated Devices. E. T. R. Murray & G. F. Shotter. April 6th.

5,260. Dynamo-electric Machines. British Thomson-Houston Co., N. Shuttleworth & G. M. Brown. April 7th.

5,741. Devices for the Discharge of Electricity through a Vacuum, Gases, or Vapours. British Thomson-Houston Co. (General Electric Co., U.S.A.). April 16th.

8,028. Electrical Measuring Instruments. H. C. West. May 31st.

8,204. Electric Batteries. W. Hoppie. June 2nd.

9,003. Miners' Electric Safety Lamps. J. G. Patterson. June 18th.

9,706. Spring Return Mechanism for Electric Motor Controllers and for other purposes. Electric & Ordnance Accessories Co., N. G. Langrish and L. Hodgson. July 3rd.

9,903. Electrical Connections, particularly applicable to the Sparking Plugs of Internal-combustion Engines. J. A. Kennedy-McGregor. July 7th.

10,325. Electrically-driven Luggage Truck. J. E. Hamilton. July 15th.

10,422. Connection and Insulation of Taps on Electric Transformers and similar apparatus. J. Wood, H. G. Furlong & Ferranti, Ltd. July 17th.

10,518. Apparatus for Converting Electrical Currents. G. Giandinoto and S. Scuderi-Scuderi. July 20th. (July 21st, 1914.)

10,598. Rheostat Switches and the like. J. Roothaan & Ferranti, Ltd. July 21st.

15,761. Replenishing Electrolytic Cells. W. S. Smith. November 8th. (June 3rd, 1915.)

16,441. Apparatus for Transmitting Morse and like Code Signals. P. W. Steele. November 22nd.

17,455. Installations and Apparatus for use in Wireless Telegraphy and Telephony. E. Bellini. December 13th.

17,542. Projector Lamp for use with Incandescent Filaments. Robert Bosch (firm of). December 15th. (February 18th, 1915.)

17,551. Sound Transmitting Devices Employing a Diaphragm. F. Morano. December 15th. (Divided application on 82/15. January 2nd.)

17,713. Electrically-heated Stove or Open Fire. G. A. C. Thynne. December 18th.

1916.

2,266. Electrically-operated or Controlled Indicating Apparatus for use with Signalling Apparatus on Railways. J. P. O'Donnell. February 15th. (Patent No. 100,215.)